AFFDL-TR-78-153
VOLUME II

② LEVEL III
A068719

AIRCRAFT TRANSPARENCY FAILURE & LOGISTICAL COST ANALYSIS
VOLUME II DESIGN DATA & MAINTENANCE PROCEDURES

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DECEMBER 1978

Final Report June 1977 – September 1978

AIR FORCE FLIGHT DYNAMICS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved for publication.

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AIR FORCE/56780/16 April 1979 — 450

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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AFFDL-TR-78-153 Vol 2
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): AIRCRAFT TRANSPARENCY FAILURE AND LOGISTICAL COST ANALYSIS. VOLUME II. DESIGN DATA & MAINTENANCE PROCEDURES
5. TYPE OF REPORT & PERIOD COVERED: Final Report, June 77 - September 78
6. PERFORMING ORG. REPORT NUMBER: NA-78-604 -VOL-2
7. AUTHOR(s): S. S. Brown
8. CONTRACT OR GRANT NUMBER(s): F33615-77-C-3060
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Rockwell International, Los Angeles Division, 815 Lapham Street, El Segundo, CA 90245
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: Program Element 62201F, Project 2402, Task 240203, Work Unit 24020302
11. CONTROLLING OFFICE NAME AND ADDRESS: Air Force Flight Dynamice Laboratory (FER), AF Wright Aeronautical Laboratories, AFSC, Wright Patterson Air Force Base, Ohio 45433
12. REPORT DATE: December 1978
13. NUMBER OF PAGES: 136
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)
15. SECURITY CLASS. (of this report): Unclassified
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Available in DDC

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Transparency Components, Interactive Support Systems, Design Characteristics, Qualification & Testing, Field Audits, Reliability, Maintainability, Cost Trades, Air Logistics Center, A/F Operational Base, Installation Procedures, Maintenance Procedures, Aircraft Windshields, Aircraft Canopies, Aircraft Windows

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The aircraft transparency and logistical cost analysis program is aimed at reducing the logistical costs associated with transparency systems for 20 of the current Air Force inventory aircraft. The approach for achieving this goal was to collect all information relating to the physical and performance characteristics, and maintenance historical data of the selected study aircraft. These data provide the means of initiating search for design improvement and cost reduction studies. In order to assess the maintenance and log-

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. Abstract Continued

istical support activity as currently being practiced at the Air Logistics Centers and Air Force Operational Bases, both maintenance and installation procedures, as well as qualification and testing procedures, for transparency components and support systems were collected. These data were assembled to determine the support structure level of effort and costs to identify those procedures and practices where cost reduction may be achieved. The means of supplementing and validating the collection of maintenance procedures and logistical support was through the field audit of five Air Logistics Centers, eight Air Force Bases, and various airframe, transparency manufacturers. These data plus the failure analysis conducted in the transparency analysis phases provided the basis for implementing the design improvement and cost reduction studies shown in volume III.

FOREWORD

The study presented in this report was performed by the Los Angeles Divison (LAD) of Rockwell International Corporation (Rockwell) under U.S. Air Force, AFSC, ASD, Wright-Patterson Air Force Base Contract F33615-77-C-3060. This study was performed for the Recovery and Crew Station Branch (FER), Vehicle Equipment Division (FE), Air Force Flight Dynamics Laboratory, Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, Ohio under Project 2402 "Vehicle Equipment Technology", Task 240203 "Aerospace Vehicle Recovery and Escape Subsystems", Work Unit 24020302 "Aircraft Transparency Failure and Cost Analysis". Mr. C. A. Babish III (AFFDL/FER) was Laboratory Contract Manager.

This program was started 15 June 1977 and submitted by the authors for approval 29 September 1978. The report was released under NA-78-604 by Rockwell for internal control.

Mr. W. D. Dotseth was the Program Manager for Rockwell. Contributing technical personnel were S. S. Brown, Deputy Program Manager, Engineering Specialties; O. F. Niedermann, Engineering Specialties; H. L. Hayes, Transparency Design; R. H. Ewald, Jr, Operation and Proposals Estimating; and W. H. Hatton of Reliability.

The author wishes to thank the field audit contacts in the Air Force, in the airframe industry, and transparency suppliers for their cooperation and valuable assistance in collection of maintainability and logistical support data.

This report is assembled in three separate volumes to provide a presentation of study results that permits easier access to and handling of the data collected and presented herein. The separate volumes are:

Volume I - PROGRAM SUMMARY
Volume II - DESIGN DATA AND MAINTENANCE PROCEDURES
Volume III - TRANSPARENCY ANALYSIS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

A/C	Aircraft
ACI	Analytical Condition Inspection
AEDC	Arnold Engineering Development Center
AFB	Air Force Base
AFFDL	Air Force Flight Dynamics Laboratory
AFH	Flight Hours (From AFM 66-1)
AFL	Number of Flights (From AFM 66-1)
AFLC	Air Force Logistics Command
AFM	Air Force Manual
AFM 66-1	Maintenance Management System
AFM 65-110	Standard Aerospace Vehicle and Equipment Inventory, Status, and Utilization Reporting
AFM 127-1	Accident/Incident Data
AFR	Air Force Regulation
AFSC	Air Force Systems Command
AFTO	Air Force Technical Order
ALC	Air Logistics Center
AMS	Avionics Maintenance Squadron
ASTM	American Society for Testing and Materials
AT	Action Taken
ATF/LCA	Aircraft Transparency Failure and Logistics Cost Analysis
BLIS	Base Level Inquiry System
CON-C	Condemnation Costs
CRC	Cost Reduction Curve
DCM	Deputy Commander - Maintenance
DDCC	Delaminations, Deterioration, Cracks, and Chipping
D056	Product Performance System
D062	Spares Requirement System
DS	Distribution and Supply
EUMR	Emergency Unsatisfactory Materiel Report
FE	Vehicle Equipment Division
FER	Recovery and Crew Station Branch
FH	Flight Hours

LIST OF ABBREVIATIONS (Continued)

FMC	Field Maintenance Cost
FMEA	Failure Modes and Effect Analysis
FMS	Field Maintenance Squadron
FSN	Federal Stock Number
HDP	Hydropress Die
HM, How Mal	How Malfunction
HTF	Heat Treat Fixture
IN	Information Office
INS	Inches
IROS	Increased Reliability of Operational Systems
KFH	Flight Hours (From K051)
KFL	Number of Flights (From K051)
K051	Logistical Support Cost (IROS)
(L)	Left-Hand Side
LAD	Los Angeles Division (Rockwell International)
LB	Pounds
LCC	Life Cycle Cost
LG	Laminated Glass
(L/R)	Left- and Right-Hand Sides
LRU	Line Replaceable Unit
LSC	Logistical Support Cost
MA	Maintenance
MAM	Maintenance Analysis Model Program
MDCS	Maintenance Data Collection System (AFM 66-1)
MDR	Maintenance Demand Rate
MIPS	Material Improvement Projects
MM	Material Management
MMH	Maintenance Man-Hours
MMH/FH	Maintenance Man-Hours per Flight Hour
MMH/MA	Maintenance Man-Hours per Maintenance Action
MTBF	Mean Time Between Failures
MTBMA	Mean Time Between Maintenance Action
MTBR	Mean Time Between Removal

LIST OF ABBREVIATIONS (Continued)

MTBUR	Mean Time Between Unscheduled Removal
MTSL	Master Transparency System List
MU	Wavelength - Millimicrons
NDI	Nondestructive Inspection
NO. (#)	Number
NOC	Not Otherwise Coded
NORM	Not Operationally Ready - Maintenance
NORS	Not Operationally Ready - Supply
NRTS	Not Repairable This Station
NSN	National Stock Number
NTIS	National Technical Information Service
OAFB	Operational Air Force Base
OMS	Organizational Maintenance Squadron
PC	Polycarbonate
P/C	Pilot and Copilot
PDM	Programed Depot Maintenance
P/FFLABORT	Primary Failure Discovered After Flight Abort
P/FGRABORT	Primary Failure Discovered After Ground Abort
PFP	Production Flat Pattern
POMO	Production Oriented Maintenance Organization
PP	Procurement and Production
PPG	Pittsburg Plate Glass Industries
PSC	Packaging and Shipping Costs
PVB	Polyvinyl Butaryl
Q/C	Quality Control
(R)	Right-Hand Side
RAM	Reliability and Maintainability Program
RI/LAD	Rockwell International/Los Angeles Division
ROK	Recheck OK
R&R	Repair and Reclamation
RRS	Repair and Reclamation Shop
SA	Stretched Acrylic
SRC	Specialized Repair Costs

SRD	Steel Rule Die
TCTO	Technical Compliance Technical Order
TO	Technical Order
TT	Task Time
UCLA	University of California at Los Angeles
UMA	Unscheduled Maintenance Actions
USAF	United States Air Force
WBS	Work Breakdown Structure
W/S	Windshield
WUC	Work Unit Code

ALCS	Air Logistic Centers
OC-ALC	Oklahoma City ALC, Tinker Air Force Base, Oklahoma
OO-ALC	Ogden ALC, Hill Air Force Base, Utah
SA-ALC	San Antonio ALC, Kelly Air Force Base, Texas
SM-ALC	Sacramento ALC, McClellan Air Force Base, California
WR-ALC	Warner Robins ALC, Warner Robins Air Force Base, Georgia

SECTION I

INTRODUCTION

This study is programmed to survey the maintenance and installation procedures of the current Air Force inventory transparency systems including windshields, canopies, cabin windows, and interactive support systems. The survey was conducted at five air logistics centers and eight selected Air Force operational bases to identify the high-cost, high-frequency maintenance items for 20 selected aircraft (figure 1). The ultimate purpose was to identify corrective programs that will reduce logistical cost.

This program is an extension of two previous programs (references 1 and 2) that were conducted to study failure modes, maintenance procedures, and the associated logistical support costs for transparency systems. The extent of the analysis developed in these previous studies was to search historical maintenance and logistical cost records, and categorize the physical transparency characteristics, failure modes, frequency of failures, and costs in a readily identifiable and inclusive statement of the problem.

The intent of this study is to expand the research of the transparency problems in greater depth, identify and recommend changes in maintenance procedures, and recommend design improvements that will reduce failures and cost of maintenance.

This volume contains the assembly of design data and maintenance procedures collected to provide a means of: (1) summarizing the transparency physical characteristics for use in the failure analysis, (2) identifying the descriptive design data for the design improvement studies, and (3) furnishing the costs required for requalification and test.

BOMBERS
- B-52, B-57, AND FB-111

ATTACK
- A-7D AND A-37

CARGO/TRANSPORT
- C-5, C-9, C-130, C/KC-135, AND C-141

FIGHTERS
- F-4, F-15, F-105, AND F-111

TRAINERS
- T-37, T-38, AND T-39

OBSERVATION/UTILITY
- O-2 AND OV-10

HELICOPTERS
- CH-3, CH-53, AND UH-1

Figure 1. Study Aircraft

SECTION II

TASK I - COLLECTION OF DATA AND INFORMATION

AIRCRAFT TRANSPARENCY SYSTEM

The definition of Aircraft Transparency System, as utilized in this study, is comprised of three categories. They are:

1. Transparency components

2. Interactive support systems

3. Support structures

The transparency components consist of the primary elements of windshield panel assemblies, canopy transparency and frame assemblies, and cabin windows. The makeup of the interactive support system consists principally of anti-icing and antifogging systems, etc. The depth of study of these systems was limited to the levels that were readily identifiable in the -06 "Work Unit Code Manual". Support structure considered only those elements that form an edge member, adjacent post or frame, and longeron or sill. Figure 2 summarizes the breakdown of transparency systems.

MASTER TRANSPARENCY SYSTEMS LIST

The Master Transparency Systems List (MTSL) was assembled to provide a detailed listing of the elements of each transparency system for each aircraft model as defined in the previous section. The MTSL is the transparency identifier and also includes the AFLC designations such as manufacturer part number and national stock number. In addition to the description and nomenclature the unit costs, principally for the transparency components, are also noted in this table. Also shown are the Logistic Support Cost Rank of the five highest

cost Work Unit Code (WUC) items within each transparency system, the description of the Major How Mal for the WUC item, and the percentage of Maintenance Man-Hours expended on the WUC item as a result of the Major How Mal. Due to the extensive assembly of data items, the MTSL is incorporated as Appendix A of this document.

TRANSPARENCY CONFIGURATION SUMMARY

The 20 aircraft reviewed in this study represent a wide spectrum of design and performance requirements. In meeting these requirements, the transparency systems incorporated in this aircraft resulted in a wide range of configuration shapes, type of construction, and interactive support systems. Figure 3, transparency configuration matrix, was assembled to provide a quick summary of the general arrangements for these transparency systems.

COMPONENTS

1. WINDSHIELDS
2. CANOPIES
3. WINDOWS

INTERACTIVE SUPPORT SYSTEMS

1. ANTI-ICING
2. DEFOGGING
3. RAIN REMOVAL
4. OPERATING AND ACTUATION
5. PRESSURIZATION

SUPPORT STRUCTURES

1. FRAMES
2. POSTS
3. LONGERONS & SILLS

Figure 2. Aircraft Transparency Systems

Aircraft Model	Windshield						Canopy						Windows						Subsystems					
	Glass	As-cast acrylic	Stretched acrylic	Polycarbonate	Vinyl	Silicone	Glass	As-cast acrylic	Stretched acrylic	Polycarbonate	Vinyl	Silicone	Glass	As-cast acrylic	Stretched acrylic	Polycarbonate	Vinyl	Silicone	Anti-icing	Defogging	Rain removal	Mech opr mech	Elect opr mech	Other
B-52	●				●								●				●		●			●		
B-57	●	●			●			●			●								●	●		●		
FB-111	●					●	●					●							●		●	●		
A-7D	●		●		●															●				
A-37		●		●					●															
C-5	●				●										●		●		●	●		●		
C-9	●				●										●		●		●	●	●	●		
C-130	●				●								●				●		●			●		
C/KC-135A	●				●								●				●		●	●	●	●		
C-141	●				●										●				●	●	●	●		

Figure 3. Transparency Configuration Matrix.

Aircraft Model	Windshield						Canopy						Windows						Subsystems					
	Glass	As-cast acrylic	Stretched acrylic	Polycarbonate	Vinyl	Silicone	Glass	As-cast acrylic	Stretched acrylic	Polycarbonate	Vinyl	Silicone	Glass	As-cast acrylic	Stretched acrylic	Polycarbonate	Vinyl	Silicone	Anti-icing	Defogging	Rain removal	Mech opr mech	Elect opr mech	Other
F-4	●		●		●				●										●		●	●		
F-15			●						●										●	●				
F-105	●		●		●				●										●	●	●			
F-111	●					●	●			●		●							●		●	●		
T-37		●		●				●														●		
T-38			●						●											●		●		
T-39	●				●									●	●		●		●			●		
O-2		●												●										
OV-10	●		●		●				●															
CH-3		●												●					●					
CH-53		●												●	●				●					
UH-1		●												●										

Figure 3. Transparency Configuration Matrix. (Concl)

TRANSPARENCY PANEL DESIGN CHARACTERISTICS

The design data presented in this section has been collected from the most recently available drawings, from discussions with the aircraft manufacturer's design engineers, and from field audit trips.

The transparent panel installations, used on aircraft reviewed in this study, fall into four categories. Two categories are related, in that they pertain to aircraft that utilize structurally enclosed crew and passenger compartments. The first category usually uses complex, laminated transparent panels, while the second category uses less sophisticated, monolithic transparent panels.

The last two categories of transparent panel installations are also related, in that they are used on aircraft in which the crew and passenger compartments are enclosed within a transparent canopy. One category uses a flat, laminated windshield, while the last category uses a contoured windshield.

LAMINATED WINDSHIELD/WINDOW PANELS

Aircraft that utilize laminated transparent panels are the B-52, C-5, C-9, C-130, KC-135, C-141, and the T-39. Transparency characteristics for these aircraft are shown in figure 4. These aircraft operate in an environment that requires pressurization, windshield heating and some degree of birdproofing.

The windshields on each of these aircraft are made of two or more laminates of glass, joined with vinyl interlayers; with various arrangements of metal inserts, phenolic and fiberglass spacers and reinforcements used around the perimeter of the panels.

The remaining transparent panels for the B-52, C-130, and the C/KC-135 are also glass-vinyl sandwiches. The exceptions, however, are the eyebrow

windows for the B-52, which are monolithic panels of stretched acrylic, and the KC-135 boom sighting door indow which is an unpressurized, monolithic acrylic panel.

The remaining aircraft in this group, the C-5, C-9, C-141, and the T-39, use window panels made of stretched acrylic laminates joined by vinyl interlayers. The C-9 and T-39 use some windows made of acrylic panels with an intervening space that is vented to the cabin air.

MONOLITHIC WINDSHIELD/WINDOW PANELS

Structurally enclosed crew compartment type aircraft that utilize monolithic transparent panels are the O-2, CH-3, CH-53, and the UH-1. Transparency characteristics for these aircraft are shown in figure 5. Generally these aircraft operate in an environment that does not require pressurizing or windshield heating; bird impact requirements are also less severe. All of the transparent panels used on these aircraft are single-sheet acrylic material, except the center and main windshields used on the CH-53, which are laminated, heated panels.

CANOPY ENCLOSURE WITH FLAT LAMINATED WINDSHIELD

A third category of aircraft uses a flat, laminated windshield panel in conjuncton with a canopy-enclosed crew compartment. These include the B-57, A-7, F-4, F-105, and the OV-10. Transparency characteristics for these aircraft are shown in figure 6. The windshield panels for these aircraft are made of three to five glass laminates joined with vinyl interlayers. In the case of the OV-10, the number of laminates is not specified, except that the panel must meet the requirements for MIL-G-5485 bulletproof glass. The other transparent panels used on these aircraft are made of acrylic material. The B-57 uses a monolithic windshield side panel made of stretched acrylic, and the canopies are made of two laminates of acrylic with a vinyl interlayer. The F-105 windshield side panels and canopies are made of two acrylic panels

with an intervening air gap. The remaining transparent panels, used on the A-7, F-4, and the OV-10, are monolithic stretched acrylic.

CANOPY ENCLOSURE WITH CONTOURED WINDSHIELD

The FB-111, F-111, A-37, T-37, F-15, and the T-38 use fully contoured windshields. See figure 7 for characteristics of transparent panels used on these aircraft. The FB-111 and the F-111 windshields and canopies are made of two glass laminates with a silicone interlayer.

The A-37 and T-37 aircraft now use a birdproofed windshield made of polycarbonate with an inner and outer protective layer of acrylic. The canopies are monolithic stretched acrylic.

The F-15 aircraft were originally produced with hard coated, monolithic polycarbonate windshield and canopies. Because of short life and excessive maintenance cost there is a retrofit program in progress to replace all F-15 windshields and canopies with monolithic, stretched acrylic units.

The T-38 uses contoured, monolithic, stretched acrylic panels for the forward student's windshield and two canopies. In addition there is a flat, stretched acrylic aft instructor's windshield. This windshield is not normally exposed to the outside air; however, it offers protection for the instructor in the event the forward canopy should open for any reason.

Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
B-52G/H	Windshield 1 (center) (11DC6)	PPG Ind 10-1389 10-30347	Flat	1.03; Outside moldline; 0.19 semi temp glass; 0.34 PVB; 0.50 full temp glass	685	50	1.03
B-52G/H	Window 2 (pilot and copilot) (11DCR)	PPG Ind 10-1389 10-30347	Flat	1.03; Outside moldline; 0.19 semi temp glass; 0.34 PVB; 0.50 full temp glass	761	55	1.03
B-52G/H	Sliding window 3 (pilot and copilot) (11DCT)	PPG Ind 10-1389 10-30347	Flat	0.84; Outside moldline; 0.19 semi temp glass; 0.27 PVB; 0.38 full temp glass	442	26.6	0.84
B-52G/H	Window 4 (pilot and copilot) (11DC7)	PPG Ind 10-303 10-30347	Flat	0.78; Outside moldline; 0.19 semi temp glass; 0.28 PVB; 0.31 full temp glass	453	24.7	0.78
B-52G/H	Window 5 (pilot and copilot) (11DC8)	PPG Ind 10-1389 10-30347	Flat	0.84; Outside moldline; 0.14 semi temp glass; 0.32 PVB; 0.38 full temp glass	380	22.0	0.84
B-52G/H	Window 6 (pilot and copilot) part of (11DCS)	Mfg unknown 25-10378	Curved	0.56; Stretched acrylic	130	3.2	0.56
B-52G/H	Window 7 (one Window) part of (11DCS)	PPG Ind 10-1389	Flat	Information not available (NA)	208	(NA)	(NA)

Figure 4. Laminated Windshield/Window Panels

Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
C-5A	Center windshield (11AAA)	Libby-Owens Ford 4F11000	Flat	1.46: Outside Moldline; 0.25 semitemp glass; 0.40 PVB; 0.50 fulltemp glass; 0.19 PVB; 0.12 low temp glass	740	75	1.46
C-5A	Main windshield (pilot and copilot) (11AAB)P (11AAC)C	PPG Ind 4F11102	Flat	1.70: Outside Moldline; 0.25 semitemp glass; 0.40 PVB; 0.75 full temp glass; 0.18 PVB; 0.12 low temp glass	1,236	148	1.70
C-5A	Sliding clear vision (pilot and copilot) (11AAF)P (11AAG)C	Sierracin Corp 3F20186	Flat	1.4: Outside Moldline; 0.75 stretched acrylic; 0.30 PVB; 0.35 stretched acrylic	800	45	1.40
C-5A	Side panel (pilot and copilot) (11AAD)P (11AAE)C	Sierracin Corp 3F20184	Flat	1.4: Outside Moldline; 0.75 stretched acrylic; 0.25 PVB; 0.40 stretched acrylic	555	33.64	1.40
C-9	Center windshield 11131	LOF and PPG 5887275-501	Flat	1.425: Moldline; 0.187 semitemp glass; 0.360 vinyl; 0.625 full temp glass; 0.065 vinyl; 0.187 semitemp glass	380	35.3	1.125
C-9	Side windshield (R/L) 11131	LOF and PPG (L) 5912290-501 (R) 5912290-502	Flat	Same	423	39.3	1.125
C-9	Clear vision window (R/L) 11150	(L) 5912426-1 (R) 5912426-2	Compound contour	1.025: Moldline; 0.750 stretched acrylic; 0.150 vinyl; 0.125 stretched acrylic	360	33.5	1.125

Figure 4. Laminated Windshield/Window Panels (Cont).

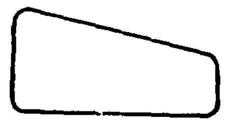
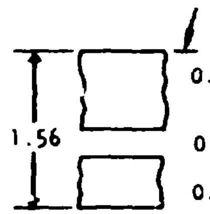
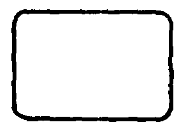
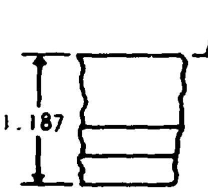
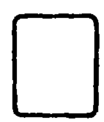
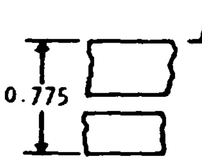
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
C-9	Flight compt window (R) and (L) 11140	(L) 5614212-1 (R) 5614212-2	Compound contoured 	 1.56 Moldline 0.75 stretched acrylic 0.25 air gap 0.56 stretched acrylic	320	29.3	1.125
C-9	Flight compt upper window (R/L) 11140	(L) 5912415-1 (R) 5912415-2	Compound contoured 	 1.187 Moldline 0.750 stretched acrylic 0.250 vinyl 0.187 stretched acrylic	254	23.6	1.125
C-9	Cabin window panel 11221	Inner 3912038-501 Outer 3912039-1	Wrapped contour 	 0.775 Moldline 0.400 stretched acrylic 0.125 air gap 0.250 stretched acrylic			

Figure 4. Laminated Windshield/Window Panels (Cont).

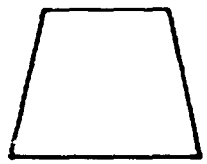
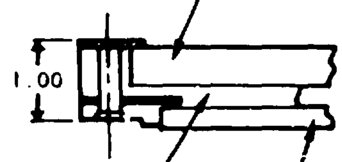
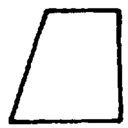
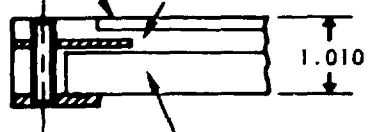
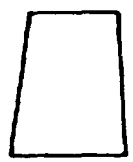
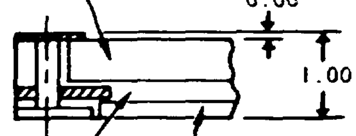
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
C-130	Center windshield (11111)	PPG 337279-9			731	60	1.010
C-130	Side windshield (R/L) 1111L (L) 11113 (R)	PPG 338125 338125-9 338125-10			336	27.5	1.00
C-130	Aft windshield (R/L) 1111M (L) 11114 (R)	PPG 338126L 338126R			393	31.3	1.00

Figure 4. Laminated Windshield/Window Panels (Cont).

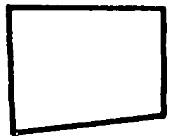
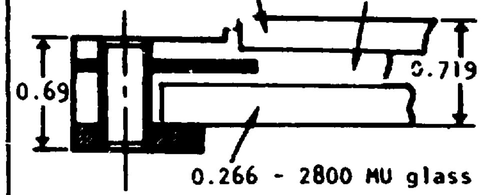
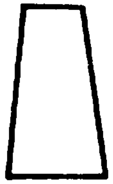
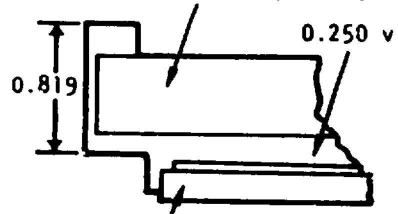
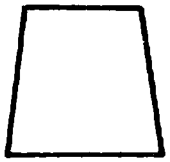
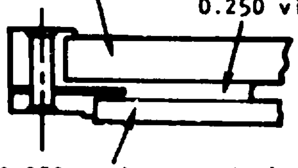
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
C-130	Fwd lwr window (L/R) 1111Q (L) 1111A (R)	PPG 338128-9 338128-R			180	10	0.719
C-130	Clear vision windshield (L/R) 1111N (L) 11115 (R)	PPG 338135-9 338135-10			288	20	0.880
-130	Front windshield (L/R) 1111K (L) 11112 (R)	PPG 338124-9 338124-10			511	42	1.01

Figure 4. Laminated Windshield/Window Panels (Cont).

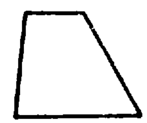
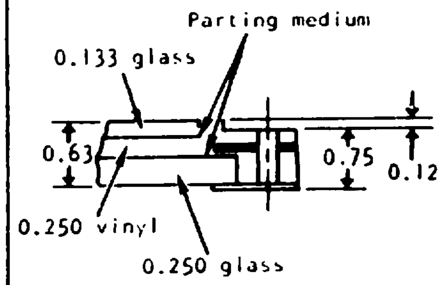
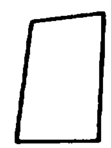
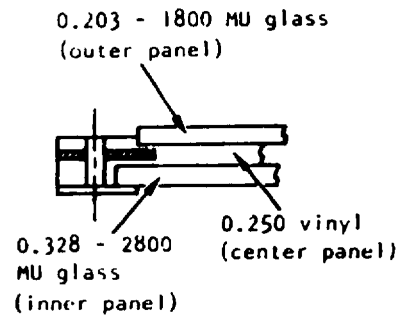
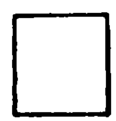
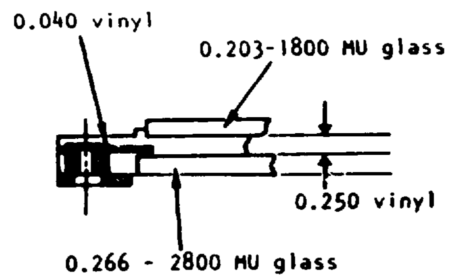
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
C-130	Aft skylight (R/L) 1112J (L) 11124 (R)	PPG 338132 L 338132 R			344	16.4	0.633
C-130	Front skylight (R/L) 1112T (L) 11126 (R)	PPG 338131 L 338131 R			127	7.8	0.781
C-130	Fwd upper window (R/L) 1111P (L) 11118 (R)	PPG 338127-9 338127-R			207	11.5	0.719

Figure 4. Laminated Windshield/Window Panels (Cont).

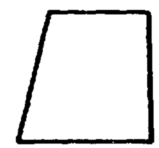
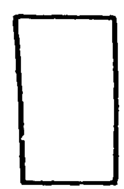
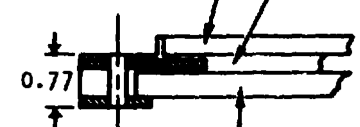
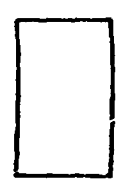
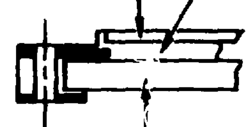
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
C-130	Center skylight (R/L) 11125 (L) 11125 (R)	PPG 337096 L 339096 R			178	10.9	0.781
C-130	Fwd side window (R/L) 1112F (L) 11121 (R)	PPG 338129 L 338129 R			312	19.1	0.781
C-130	Aft side window (R/L) 1112G (L) 11122 (R)	PPG 338130 L 338130 R			395	23.5	0.763

Figure 4. Laminated Windshield/Window Panels (Cont).

Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
KC-135A	Windshield 1 (pilot and copilot) (1114H)	PPG Ind 5-89354	Flat	1.07; Outside moldline; 0.19 semi-temp glass; 0.38 PVB; 0.50 full temp glass	620	46	1.07
KC-135A	Sliding Window 2 (pilot and copilot) (1114J)	PPG Ind 5-89355	Flat	0.95; Outside moldline; 0.19 semi temp glass; 0.38 PVB; 0.38 full temp glass	383	24.0	0.95
KC-135A	Window 3 (pilot and copilot) (1114K)	PPG Ind 5-89356	Flat	0.85; Outside moldline; 0.19 semi temp glass; 0.28 PVB; 0.38 full temp glass	413	25.0	0.85
KC-135A	Window 4 (pilot and copilot) (1114L)	PPG Ind 5-89357	Flat	0.68; Outside moldline; 0.13 low temp glass; 0.30 PVB; 0.35 semi-temp glass	145	6.5	0.68
KC-135A	Window 5 (pilot and copilot) (1114M)	PPG Ind 5-89358	Flat	0.68; Outside moldline; 0.13 low temp glass; 0.30 PVB; 0.25 semi-temp glass	96	4.3	0.68

Figure 4. Laminated Windshield/Window Panels (Cont).

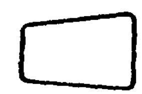
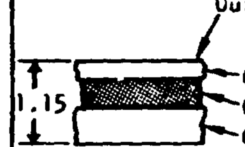
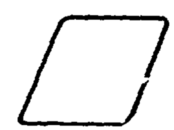
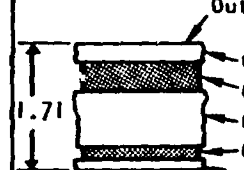
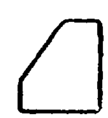
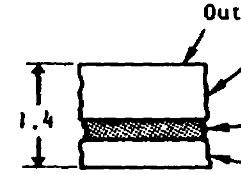
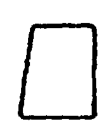
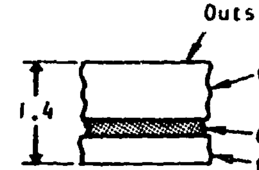
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape		Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
C-141A	Center windshield (11AAA)	PPG Ind 3F20182	Flat			546	44	1.15
C-141A	Main windshield (pilot and copilot) (11AAB) P (11AAU) C	PPG Ind 3F20183	Flat			1,020	120	1.71
C-141A	Sliding clear vision (pilot and copilot) (11AAD)	Sierracin Corp 3F20186	Flat			800	45	1.40
C-141A	Side panel (pilot and copilot) (11AAC)	Sierracin Corp 3F20184	Flat			555	33.64	1.40

Figure 4. Laminated Windshield/Window Panels (Cont).

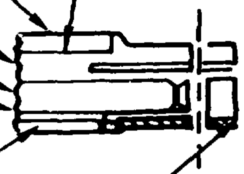
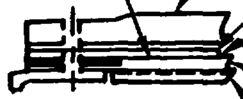
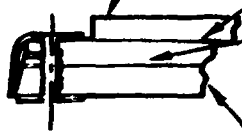
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area ($in.^2$)	Approx weight (lb)	Total thickness (in.)
T-39	Windshield (glass panel) (L/R) 11111	E1117-1 -2 265-318202 -11 -13			708	43.8	1.108
T-39	Eyebrow window panels 11146 (L/R) 11147	Inner panel 165-318207 -1 265-318207 -2 Outer panel 265-318205 -11 265-318205 -12			297	5.5	
T-39	Sliding window panel (L) 11120	265-318371 -21			136	8.0	

Figure 4. Laminated Windshield/Window Panels (Cont).

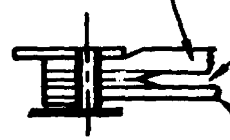
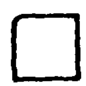
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
T-39	Corner window (R) 1114 A 1114 B	265-318208 -11			180	8.3	
T-39	Aft upper window (L/R) 11144 in 11145 out	Inner 265-318206 -31 -32 Outer 265-318206 -11 -12			143	1.8	
T-39	Aft [illegible] side window (L/R) 11142 in 11143 out	Inner 265-318204 -81 -82 Outer 265-318204 -81 -82			270	4.0	

Figure 4. Laminated Windshield/Window Panels (Cont).

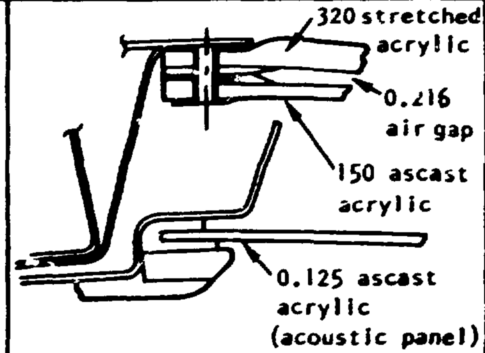
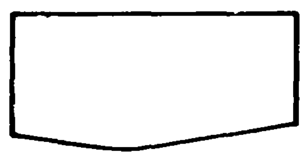
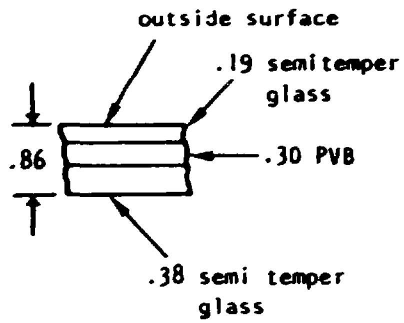
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
T-39	Cabin window (L/R)	265-300050			66	2.7	
	11172 in aft	-81					
	11173 out aft	-71					
	11174 in fwd	-21					
	11175 out fwd	-11					
KC-135A	boom sighting window	5-89359			500	30.3	.86

Figure 4. Laminated Windshield/Window Panels (Concl).

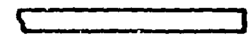
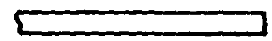
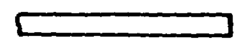
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
0-2A	Windshield 11AS1	Rohm and Haas (L) 1413702-5	Contoured 	Acrylic (0.25) 	660	7.1	0.25
0-2A	Windshield 11AS1	Rohm and Haas (R) 1413702-6	Contoured 	Acrylic (0.25)  Est	604	6.5	0.25
0-2A	Foul weather 11AQ1	Rohm and Haas 1513700-10	Contoured 	Acrylic (0.25) 	56	0.6	0.25

Figure 5. Monolithic Windshield/Window Panels.

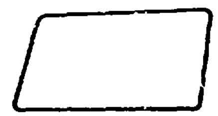
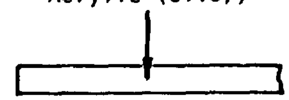
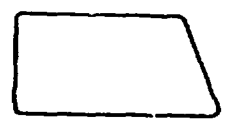
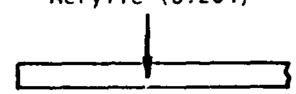
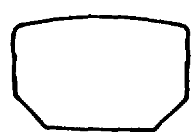
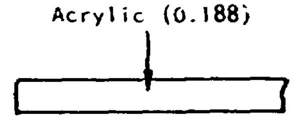
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
0-2	Emergency release window 11AR1 (L)	Rohm and Haas 1511147-1	Contoured 	Acrylic (0.187) 	175	1.4	0.187
0-2	Cabin door window 11AUC	1411312-4	Contoured 	Acrylic (0.264)  Est	519	5.9	0.264
0-2	Cabin top forward window 11AP1	Rohm and Haas 1511313-1		Acrylic (0.188) 	1,106	8.9	0.188

Figure 5. Monolithic Windshield/Window Panels (Cont).

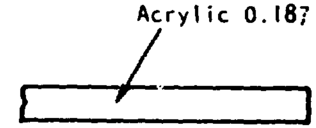
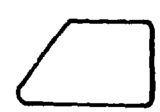
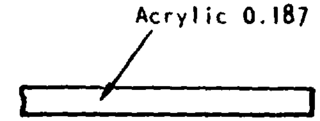
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
0-2	Cabin top aft window 11AP1	Ruhm and Haas 1511313-4	Contoured 	Acrylic (0.188) 	647	5.2	0.188
0-2	Lower cabin window 11AP1	(L) 1513314-1 (R) 1513314-2		Acrylic 0.187  Est	140	1.1	0.187
0-2	Aft fuselage window 11AP1 (L/R)	(L) 1412312-9 (R) 1412312-10		Acrylic 0.187  Est	135	1.1	0.187

Figure 5. Monolithic Windshield/Window Panels (Cont).

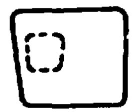
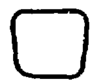
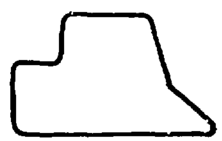
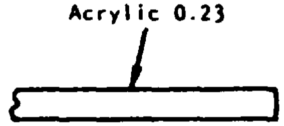
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
0-2	Middle window 11AP1 (L/R)	Rohm and Haas (L) 1511015-1 (R) 1511015-2	Contoured 	Acrylic (0.25) 	226	2.4	0.25
0-2	Access window 11AP1	(L) 1511016-1 (R) 1511016-2	Contoured 	Acrylic 0.20  Est	46	0.4	0.20
0-2	Lower cabin door window 11AUC	1511231-2	Contoured 	Acrylic 0.23  Est	455	3.9	0.25

Figure 5. Monolithic Windshield/Window Panels (Cont).

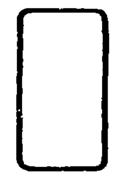
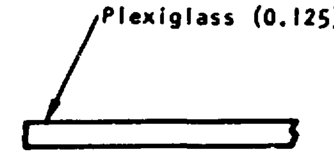
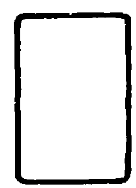
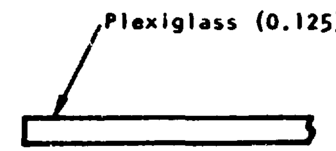
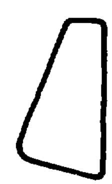
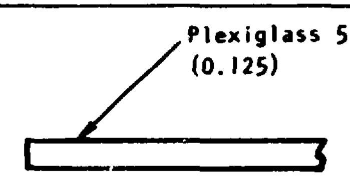
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
CH-3C	Center windshield (11111)	S6120-61229	Flat 		418	2.40	0.125
CH-3C	Main windshield (1111E) (L/R)	(L) E133400 -1 (R) E133400 -2	Curved 		794	4.3	0.125
CH-3C	Corner windshield (11111) (L/R)	(L) S6120-6122[illegible] -3 (R) S6120-61227 -4	Curved 		334	1.70	0.125

Figure 5. Monolithic Windshield/Window Panels (Cont).

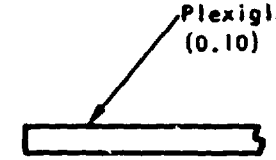
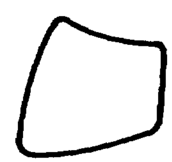
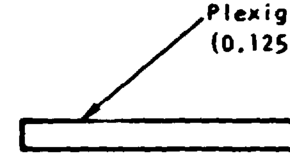
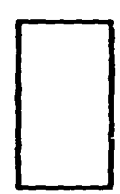
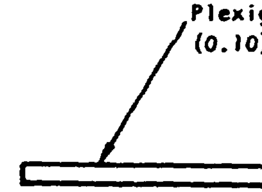
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
CH-3C	Overhead observation window (11111) (R/L)	(L) S6120-61245 -1 (R) S6120-61245 -2	Curved 	 Plexiglass 55 (0.10)	989	7.2	0.10
CH-3C	Lower observation window (11111) (R/L)	(L) S6120-61246 -3 (R) S6120-61246 -4	Curved 	 Plexiglass 55 (0.125)	585	4.5	0.125
CH-3C	Stationary window (11111) (R/L)	(L) S6120-61235 -5 (R) S6120-61235 -6	Flat 	 Plexiglass 55 (0.10)	448	2.75	0.10

Figure 5. Monolithic Windshield/Window Panels (Cont).

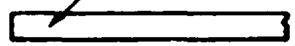
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
CH-3C	Sliding Window (11111) (L/R)	(L) S6120-61330 -11 (R) S6120-61330 -12	Flat 	Plexiglass 55 (0.187) 	386	2.51	0.187

Figure 5. Monolithic Windshield/Window Panels (Cont).

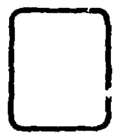
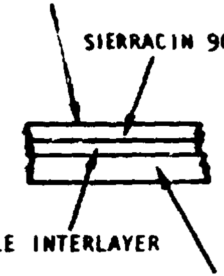
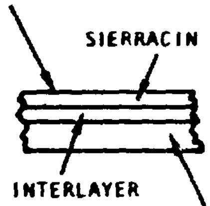
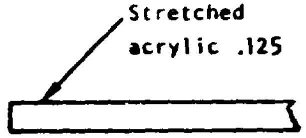
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
CH-53	Center windshield (1111D)	65206-01009 -105 E1203	Flat 		525		
CH-53	Windshield (1111B/C) (L/R)	(L) 65206-01003 -109 E1204-1 (R) 65206-01003 -110 (E1204-2)	Curved 		794		
CH-53	Overhead window 11111 (L/R)	Swedlow (L) 65206-01004 -101 (R) 65206-01004 -102	Curved 		280	1.5	.125

Figure 5. Monolithic Windshield/Window Panels (Cont).

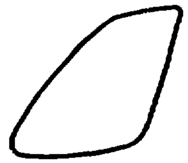
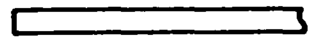
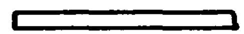
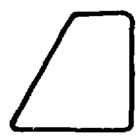
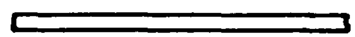
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
CH-53	Lower front window 11111 (L/R)	Swedlow (L) 65206-01006 -101 (R) 65206-01006 -102	Curved 	Stretched acrylic (0.15) 	678	6.0	0.150
CH-53	Bottom nose window (L/R) 11111	(L) 65206-01007 -101 (R) 65206-01007 -102	Curved 	0.125 acrylic 	620	4.55 (from dwg)	0.125
CH-53	Escape window 11111	Swedlow (L) 65206-01008 -105 (R) 65206-01008 -106	Flat 	Plexiglass 55 (0.125) 	687	4.21	0.125

Figure 5. Monolithic Windshield/Window Panels (Cont).

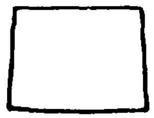
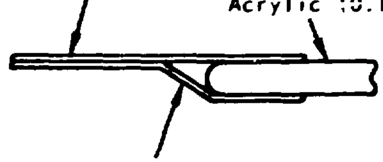
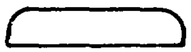
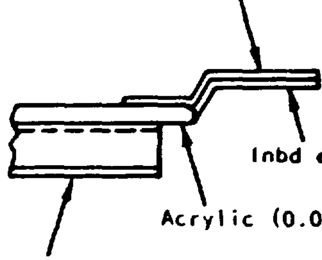
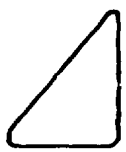
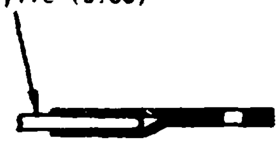
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
UH-1	Windshield (L/R) 11146	Rohm and Haas 204-030-666	Flat 		501	11.5	
UH-1	Door window (top) (fwd) (L/R) 11113	Rohm and Haas (L) 204-030-770-1 (R) 204-030-770-2	Flat 		43	0.35	
UH-1	Door window (L/R) 11113	Rohm and Haas (L) 204-030-459-1 (R) 204-030-459-2	Flat 		145	0.33	

Figure 5. Monolithic Windshield/Window Panels (Cont).

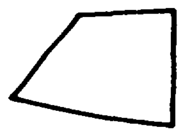
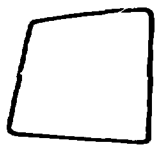
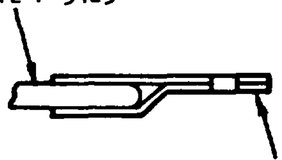
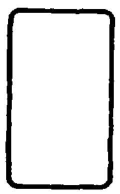
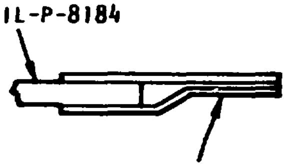
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
UH-1	Cabin nose window (L/R) 11145	Swedlow LH 204-030-657 -19 RH 204-030-657 -20	Curved 	Acryl.c (0.125) 	400	2.2	0.125
UH-1	Cabin roof window (upper) (11BAJ) (L/R) 11145	Swedlow 204-030-673 -3 204-030-673 -24	Curved 	Acrylic (0.08) MIL-P-5425  Fiberglass edges	415	7.20	0.08
UH-1	Rear door window (L/R) 11132	Swedlow 204-031-340 -1	Curved 	Acrylic (0.125) MIL-P-8184  Fiberglass edge	716	3.8	0.125

Figure 5. Monolithic Windshield/Window Panels (Cont).

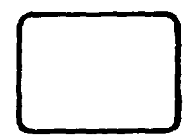
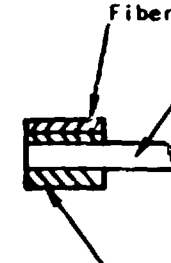
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
UH-1	Window, lower, crew door (L/R) 11113	Rohm and Haas 204-030-799 -1	Flat 		454	2.61	0.15

Figure 5. Monolithic Windshield/Window Panels (Concl).

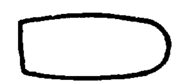
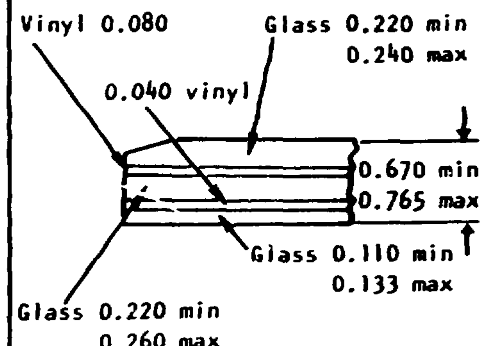
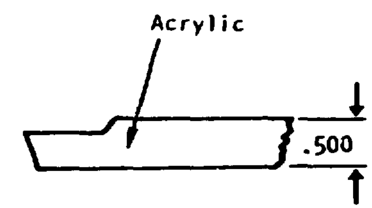
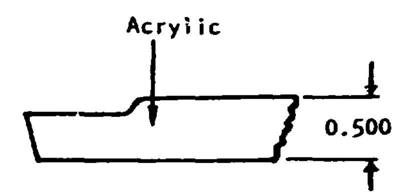
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
B-57	Windshield (fwd panel) (11153)	272B6000177	Flat 		222	13.3	0.765
B-57	Windshield (side panel) (L) (11152)	272B6000178 -3			271	5.8	0.500
B-57	Windshield (side panel) (R) (11151)	272B6000178 -4	Contoured 		271	5.8	0.500

Figure 6. Canopy Enclosure With Flat Windshield

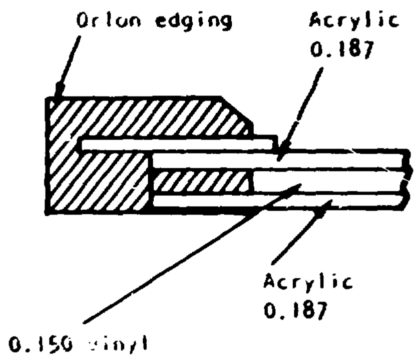
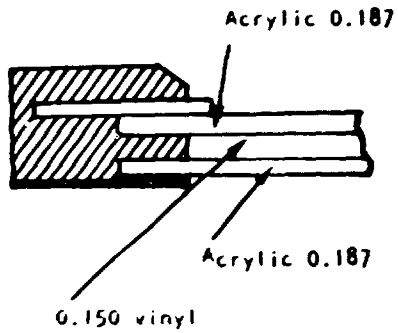
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
B-57	Fwd canopy (11111)	272B6000201 (-119)	Contoured 		2,092	50	0.524
B-57	Aft canopy (11111)	272B6000210 (-129)	Contoured 		2,092	50	0.524

Figure 6. Canopy Enclosure With Flat Windshield (Cont).

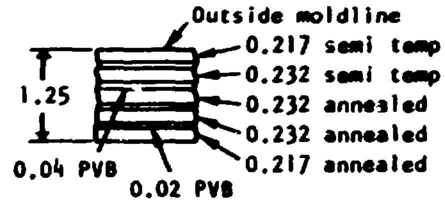
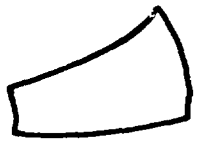
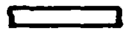
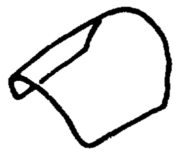
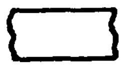
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area ($in.^2$)	Approx weight (lb)	Total thickness (in.)
A-7D	Center windshield (11ACA)	PPG Ind 216-20394	Flat-oval 		440	48	1.25
A-7D	Windshield side panels L/R (11ACB)	Swedlow 215-20396	Curved 	 0.25 stretched acryilc	763	10	0.25
A-7D	Canopy (12AAA)	Swedlow 215-20079	Curved 	 0.25 stretched acrylic	2,618	39	0.25

Figure 6. Canopy Enclosure With Flat Windshield (Cont).

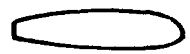
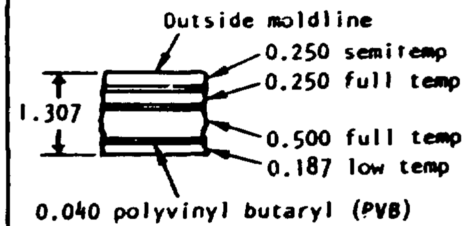
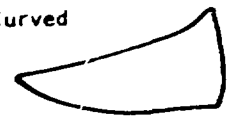
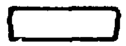
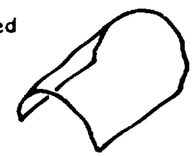
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
F-4C F-4D F-4E	Center windshield (111AQ)	PPG Ind 32-35007	Flat-oval 		305	35	1.307
F-4C F-4D F-4E	Windshield side panels L/R 111AN (R) 111AP (L)	Goodyear 32-35008	Curved 	 0.43 stretched acrylic	540	14.9	0.43
F-4C F-4D F-4E	Forward canopy (1232A)	Goodyear 32-35209	Curved 	 0.34 stretched acrylic	2,030	39.8	0.34
F-4C F-4D F-4E	Aft canopy (1235A)	Goodyear 32-35210	Curved 	 0.34 stretched acrylic	1,901	39.4	0.34

Figure 6. Canopy Enclosure With Flat Windshield (Cont).

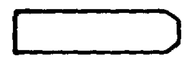
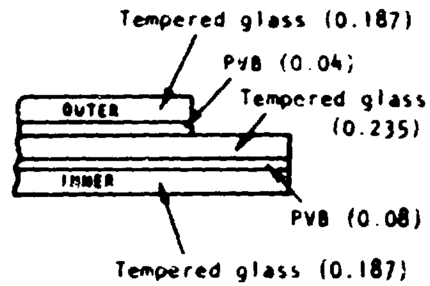
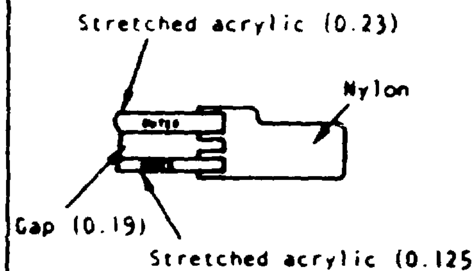
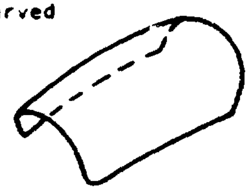
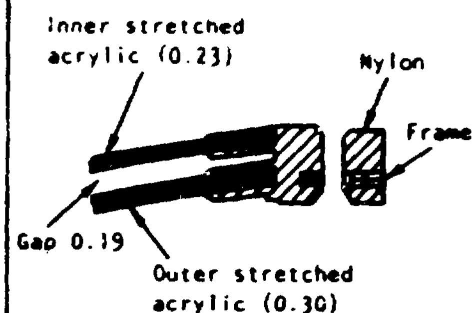
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
F-105	Front windshield (11122)	PPG 57F170103 -13	Flat 		405	40	.729
F-105	Windshield 11123 11124	Swedlow 57F171101 -7-1 57F171101 -8-1	Curved 		774	15.6	.55
F-105 B/D	Canopy B/D (12223)	Swedlow 57F171604 -9-1	Curved 		3,158	43.5	0.72

Figure 6. Canopy Enclosure With Flat Windshield (Cont).

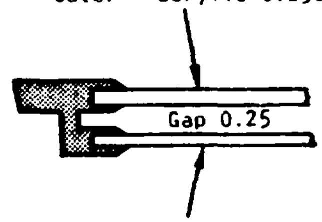
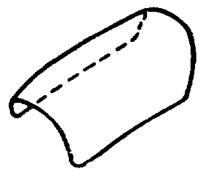
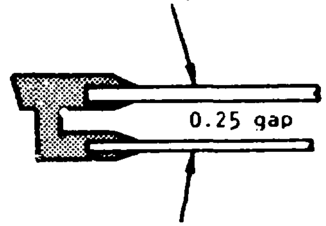
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area ($in.^2$)	Approx weight (lb)	Total thickness (in.)
F-105 F/G	Fwd canopy F/G 12242	Swedlow 31F170604-1-1	Curved 		3,158	68	0.605
F-105 F/G	Aft canopy F/G (12242)	Swedlow 31F170704-1-1	Curved 		2,457	38	0.605

Figure 6. Canopy Enclosure With Flat Windshield (Cont).

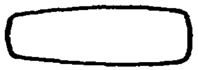
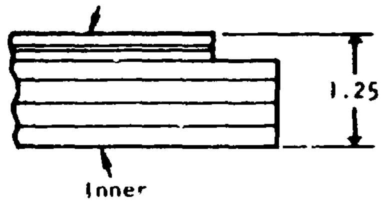
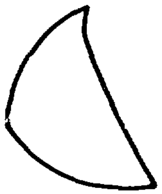
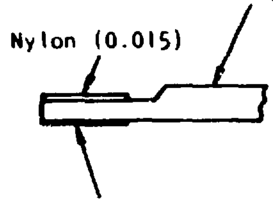
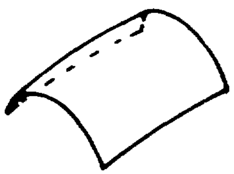
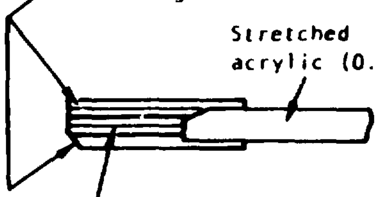
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
OV-10A	Center windshield (11AAA)	300-318032	Flat - oval 	Bullet resistant glass per MIL-G-5485  Annealed (No. plies vary)	381	39.3	..25
OV-10A	Side windshield 11AAJ (L) 11AAH (R)	(L) 300-118136 -21 (R) 300-318136 -22	Curved - conical 		666	7.2	0.250
OV-10A	Top fwd canopy (11AAB)	300-318080 -201	Curved 		1,082	11.6	0.187

Figure 6. Canopy Enclosure With Flat Windshield (Cont).

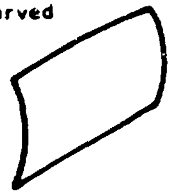
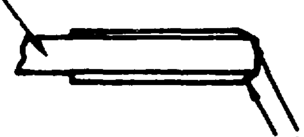
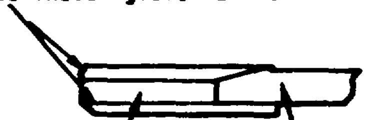
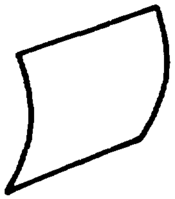
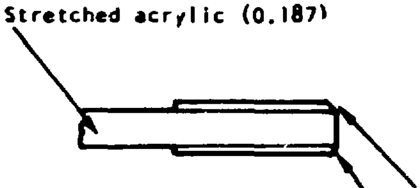
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
OV-10A	Pilot side door window 11AAE (L) 11AAD (R)	(L) 300-310137 -11 (R) 300-318137 -2	Curved 		1,043	8.4	0.187
OV-10A	Top aft canopy (11AAC)	300-318085 -101	Curved 		1,347	10.8	0.187
OV-1CA	Observer side door window 11AAG (L) 11AAF (R)	(L) 300-318138 -31 (R) 300-318138 -2	Curved 		685	5.5	0.187

Figure 6. Canopy Enclosure With Flat Windshield (Cont).

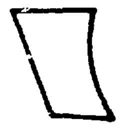
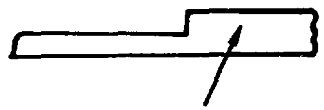
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
OV-10A	Side aft window 11AAL (L) 11AAK (R)	(L) 300-318139 -5 (R) 300-318139 -6	Curved 	 Stretched acrylic (0.187)	324	2.6	0.187

Figure 6. Canopy Enclosure With Flat Windshield (Concl).

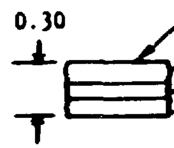
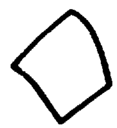
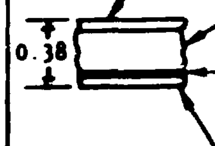
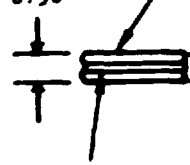
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
F-111D	Canopy (L/R) (16ABD) (L) (16ABE) (R)	PPG Ind CKO-3200	Compound curved 	 0.30; Outside mold line; 0.110 chem temp; 0.080 silicone; 0.110 chem temp	1,722	38	0.30
F-111F	Canopy (L/R) (16ABD) (L) (1EABE) (R)	Texstar CKO-0029	Compound curved 	 0.38; Protective coating; Polycarbonate; Radar reflective coating; Protective coating	1,722	26	0.38
F-111D F-111F	Windshield (L/R) 16AAC (L) 16AAD (R)	PPG Ind CKO-3200	Curved-conical 	 0.30; Outside moldline; 0.110 chem temp; 0.110 chem temp; 0.080 silicone	1,767	39	0.30

Figure 7. Canopy Enclosure With Curved Windshield.

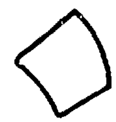
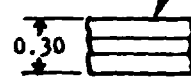
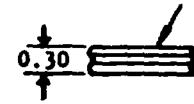
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
FB-111A	Canopy (L/R) (16ABD) (L) (16ABE) (R)	PPG Ind CKO-3200	Compound curved 	 0.30; Outside moldline; 0.110 chem temp; .080 silicone; 0.110 chem temp	1,722	38	0.30
FB-111A	Windshield L/R 16AAC (L) 16AAD (R)	PPG Ind CKO-3200	Curved-conical 	 0.30; Outside moldline; 0.110 chem temp; 0.080 silicone; 0.110 chem temp	1,767	39	0.30

Figure 7. Canopy Enclosure With Curved Windshield (Cont).

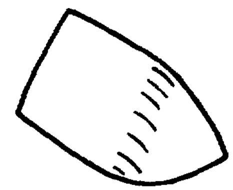
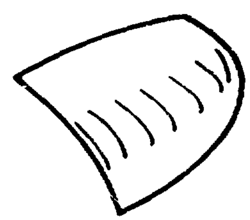
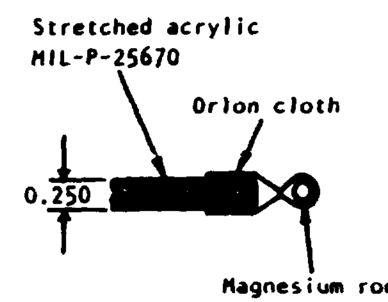
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and thickness	Approx area ($in.^2$)	Approx weight (lb)	Total thickness (in.)
A-37A	Windshield panel (L) 1111 B (R) 1111 A	(L) 4011546-3 (R) 4011546-4	Contoured 	Fabricate per spec control dwg 9900142 Outer ply 0.13 acrylic Center ply 0.63 polycarbonate Inner ply 0.13 acrylic	893		
A-37A	Canopy 1112 B (L/R)	(L) 4011708-27 (R) 4011708-26	Contoured 		1,038	2	0.25

Figure 7. Canopy Enclosure With Curved Windshield (Cont).

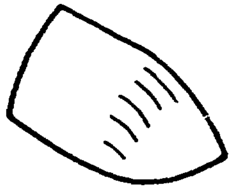
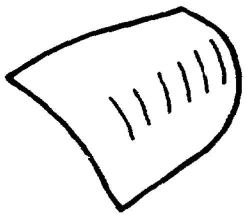
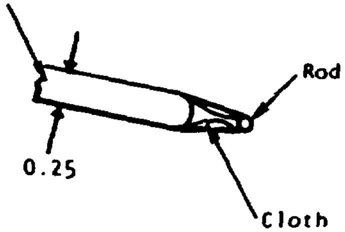
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
T-37B	Windshield panel 11112	Goodyear LH 411546-305 RH 411546-306	Curved 	Outer ply 0.13 acrylic Center ply 0.63 polycarbonate Inner ply 0.13 acrylic Fabricate per spec control dwg 9900142	893		
T-37B	Canopy (1112B) (L/R)	Goodyear LH 4011708 -23 RH 4011708 -22	Curved 	Acrylic MIL-P-8189 	1,038	11.2	0.25

Figure 7. Canopy Enclosure With Curved Windshield (Cont).

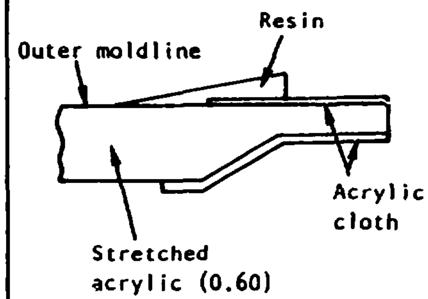
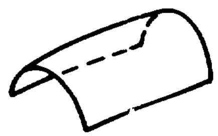
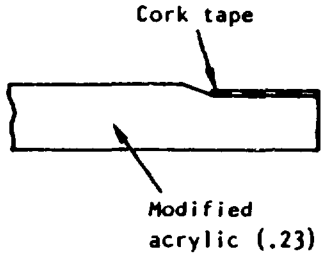
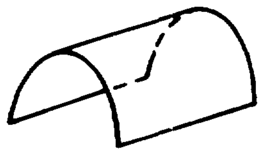
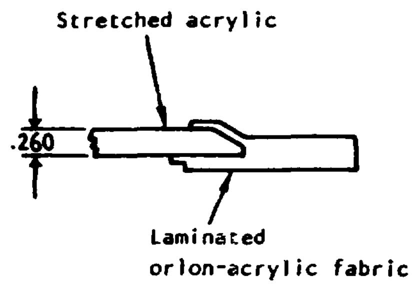
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
T-38A	Windshield glass panel front (11125)	Swedlow 3-13007-1	Curved-conical 		1,088	28.1	0.60
T-38A	Students canopy (11212)	Swedlow 2-13201 -53	Curved 		1,782	17.6	0.23
T-38A	Instructor's canopy (11312)	Swedlow 2-13301 -35	Curved 		1,391	15.6	0.260

Figure 7. Canopy Enclosure With Curved Windshield (Cont).

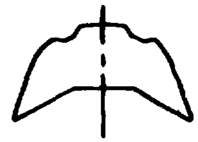
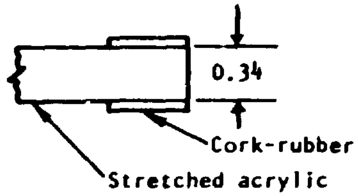
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
T-38A	Instructor's windshield panel 11136	2-13101	Flat 		336	4.90	0.34

Figure 7. Canopy Enclosure With Curved Windshield (Cont).

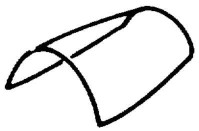
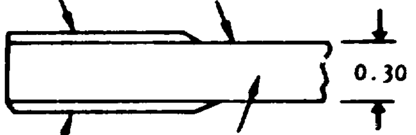
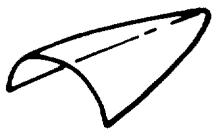
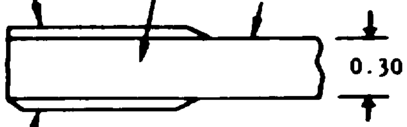
Aircraft	Transparency and (WUC)	Manufacturer and part no.	Shape	Cross section and material	Approx area (in.^{2})	Approx weight (lb)	Total thickness (in.)
F-15	Windshield panel 11AFB	68B358000	Contoured 		1,175	50	0.95
F-15	Fwd canopy 12CAA	68B358001			4,300	55.5	0.30
F-15	Aft canopy 12CAA	68B358001			1,566	20.2	0.30

Figure 7. Canopy Enclosure With Curved Windshield (Concl).

SECTION III

TASK I - QUALIFICATION TESTING PROCEDURES AND REQUIREMENTS

The data collected on the qualification and testing procedures were gathered from many sources. The sources include the ALC's, airframe manufacturers, and transparency suppliers. The data contained in this section covers the test procedures and requirements necessary to qualify the transparency system for flightworthiness. It also includes a description of the development program which generated the requirements. The presentation is in the form of data sets made up from comments assembled during the field audit phase of this program.

TESTING PROCEDURES AND REQUIREMENTS

The testing procedures utilized by both the ALC and Operational Air Force Base (OAFB) at the conclusion of a transparency repair or modification is a qualitative test in accordance with the Inspection and Maintenance Technical Orders. The tests made are:

1. Optical Qualities Test - A visual inspection is conducted by Flight and/or Quality Control personnel. Principal reliance for the inspection of optical qualities rests with flight personnel.

2. Pressurization Tests - Cabin or cockpit tests are functional in nature. The system pressure is brought up to specified levels and leakage rates checked for adherence to the tolerances specified in the -2 and -3 technical orders.

3. Water Leakage Tests - Water spray tests are conducted to determine if adequate sealing is achieved for the rain seals and panel sealant joints.

4. Test of Interactive Support Systems - The simple functional checkout of anti-icing, defogging, and mechanical systems is the first means of testing the adequacy of the repair and replacement. If additional testing is required, procedures as described in Section IV, under headings Electrical System Checkout Procedures and Checkout Procedures for Mechanisms of Operable Windows are used.

DEVELOPMENT PROGRAMS

The description of development programs for transparency systems were not made available to the audit team. During the visits to four airframe manufacturers, the data relating to development programs were considered to be proprietary, or lumped in with fuselage structure and environmental control system. Because of the integrated nature of the transparencies with the structures, environmental, and equipment subsystems, it was considered to be impractical, and in some cases impossible, to isolate the programs and costs that generated the test, certification and qualification requirements. References 8 through 10 contain the test and qualification data for the T-38 and F-5 series aircraft that were used in this study.

Reference 8. W. G. Shirreffs, "Qualification Test of T-38 Cockpit Enclosure System for Structural I.D.E. Approval," Norair Report Number NOR-61-235, Northrop Corporation, Aircraft Division, Hawthorne, CA, 6 October 1961

Reference 9. W. G. Shirreffs, "Design Test of Instructors Canted Windshield," Norair Report Number NOR-63-146, Northrop Corporation, Aircraft Division, Hawthorne, CA, 5 September 1963

Reference 10. J. A. Porter, "Qualification Test of 8-13965-5 Electrically Anti-iced Windshield," Contract F33657-68-C-1036, Norair Report Number NOR-69-117, Northrop Corporation Aircraft Division, Hawthorne, CA, September 1969

CERTIFICATION AND QUALIFICATION REQUIREMENTS

The review of comments relating to qualification of transparencies resulted in categorization of four tests utilized by the airframe manufacturers visited. They are:

1. Optical Qualities Test - The optical qualities test universally used by both the manufacturer and transparency supplier is the photographic process. This process shoots a photograph of a grid board through the test transparency simulating the attitude as normally mounted in the aircraft. The criteria for allowable slope deviation of the grid segments around the viewing areas are generally established by the Air Force procuring activity, transparency supplier, and the airframe manufacturer. The American Society for Testing and Materials (ASTM) is in the process of developing an approach for standardization of optical qualities criteria.

2. Cyclic Pressurization Test - The cyclic pressure tests are run to determine the basic strength characteristics of the transparency component as subjected to cabin cockpit pressurization and, when applicable, to variation in temperature. Additional test results obtained is the determination of the ability of structural framing, enclosure frames, and supporting members to resist fatigue.

   The cabin or enclosure transparency system, including a simulated or actual fuselage test section, is subjected to various combinations of internal and external temperatures through a range of internal pressures as would be encountered in flight and ground conditions. The canopy or window mechanisms are generally installed and rigged in accordance with applicable production drawings. Testing procedures utilized in conducting these tests are accomplished in accordance with the criteria as established and referenced in AFSC Design Handbook (Reference 11).

Reference 11. AFSC DH Series 2-0, "Design Handbook," Department of the Air Force, Headquarters Air Force Systems Command, Andrews AFB, DC 20334, 25 April 1977

3. Bird Proof Test (When Applicable) - Bird impact requirements are established at the discretion of the procuring activity and the airframe manufacturer. The procedures established define the conditions pertinent to the test to be conducted and include the methods of bird packaging, a selection of test facility, number of test articles, and the environmental conditioning. Additional parameters establish the bird weight and condition, bird velocity, and instrumentation to be used. Bird impact testing of crew compartment transparencies and supporting structure verifies design through correlation of analytical methods with laboratory simulated bird strikes. The ASTM is currently trying to establish standards for conducting bird impact tests.

4. Coupon (Strength) Test - Structural tests of transparency specimens are conducted to the extent required to demonstrate structural integrity. The extent required is generally negotiated between the manufacturer and the procuring agency. The tests include tensile and shear strength determinations for the proposed transparency concepts. Additional tests may involve thermal exposure tests such as creep test. Qualification may also involve testing for stress craze resistance caused by moisture and exposure to ultraviolet rays. Other testing to fully cover the range of environmental factors may also include test of resistance to abrasion and the integrity of adhesive bondings.

The extent of qualification testing is largely dependent on the characteristics and the mission requirements of the aircraft configuration. The requirements for follow-on derivatives may be substantially reduced by providing analysis on the basis of similarity in configuration. The procuring agency may consider this approach as being acceptable when changes to the transparency are minor. As previously stated, the American Society for Testing and Materials is in the process of recommending standardization in the qualification and testing procedures.

ASSESSMENT OF QUALIFICATION COSTS

The assessment of costs to qualify a transparency system for the preceding noted testing procedures is dependent on many factors. These include size, configuration, selected material, and type of construction. The requirements for test varies from aircraft to aircraft and are generally established by the procuring activity for each program. The availability of this type information was very limited, due to the age of the aircraft, and in most cases transparency tests were generally a part of a combined testing program involving other requirements.

On the basis of field audit data, some unit and task efforts were collected. These data are presented to provide a sampling of unit costs for estimating purposes.

Test and Procedural Cost Data

1. Edge member coupons $100 to $2,000 apiece.

2. Edge member pull test 20 to 30 times. Each test cost is $25 to $50. For elevated temperature, the test cost is $50 to $75.

3. Pressure cycle and thermal cycle test - requires 50 man-hours for each test. This includes setup and teardown time. Each test requires 15 to 20 samples at $500 to $1,500 each.

4. Optic grid board check requires anywhere from 2 minutes to 3.5 hours per panel, depending on the size of windshield. Estimated cost for this operation is $40 per hour.

Bird Proof Test Costs

The known transparency testing facilities were contacted to determine the costs associated with qualifying bird-resistant windshields and enclosures. The facilities contacted were:

1. Goodyear Aerospace Corporation, Litchfield Park, Arizona

2. ARO Inc, Arnold Engineering Development Center (AEDC), Tullahoma, Tennessee

3. National Research Council, Ottawa, Canada

4. McDonnell Douglas Aircraft, Long Beach, California

The information requested from each facility was the costing information required to requalify transparency systems. It was further requested that major costing efforts be provided to support the design improvement studies being developed. The results of these inquiries indicated that each facility utilized a different approach in establishing test costs. The three approaches used were based on: cost per shot, cost per hour, and cost per day, with adjusted allowances for downtime, and allowances for special equipment and services. Table 1, "Bird Proof Test Costs", identifies the major costing efforts associated with requalification testing. With appropriate factors unique to the aircraft transparency system testing programs, reasonably accurate estimates may be determined.

Discussions with testing personnel indicated that a significant part of the retesting costs are attributed to the test fixture and test specimens. Those costs, however, are dependent on the characteristics of each specific configuration and are consequently not included in table 1. The largest unknown factor is the number of shots required to qualify. Based on the concensus of the people talked to, as many as fifteen shots (including two to three impact positions) were required for a newly developed transparency system. The estimate based on past experience was that two to three shots were required for limited test programs. Approximately two to three shots a day can be accomplished for a simple setup. For the more complicated setups it takes 2 to 3 days to complete three shots. It should be noted that some aircraft programs require more than the average of fifteen quoted above.

MAINTENANCE AND INSTALLATION PROCEDURES

The maintenance procedural data used in support of this program mainly consisted of Air Force Technical Order Manuals for the 20 study aircraft plus technical documents oriented to or indirectly relating to transparency systems. A major portion of the maintenance and installation procedures used to correlate the maintenance actions and maintenance hours with the failure analysis was accomplished with the aid of information found in the literature review sources which are listed in figure 8. The -4 illustrated parts catalog was particularly valuable in identifying and correlating the manufacturer's part number to the -06 Work Unit Code Manual. The sources for these data were obtained from the Contractor's Data Bank and from additional manual and technical data as supplied by the AFFDL.

For the reasons presented earlier in this section under the heading Development Programs, only a limited amount of transparency installation data for both the current and out-of-production aircraft were made available to the field audit team.

AFLC - RELIABILITY AND MAINTENANCE

The principal means utilized by the AFLC to track and collect the history of maintenance activity of transparency systems is the automatic data processing system as described in the D056 product performance system (references 6 and 12). This manual defines the procedures necessary to accumulate and display all available failure information on a specific end item (WUC), by aircraft model and component, necessary to track any possible logistics problem, and in the Reliability and Maintainability Data Sources (reference 12).

Reference 12. Logistics, "Reliability and Maintainability Data Sources," AFLC/AFSC Pamphlet 400-11, Department of the Air Force, Headquarters, Air Force Logistics Command (AFLC) Wright-Patterson Air Force Base, OH 45433, Headquarters, Air Force Systems Command (AFSC) Andrews Air Force Base, DC 20334, 16 August 1974

Since the preceding programs (references 1 and 2) provided extensive definition of these processes, this report will briefly cover the programs utilized in the failure analysis conducted in Volume III of this report.

AFM 66-1 MAINTENANCE DATA COLLECTION SYSTEM

The Air Force Manual 66-1, Maintenance Data Collection System (MDCS) (reference 7), is primarily used at base level for tracking maintenance activity. It also is used and provides data to the ALC for materiel management and logistic support requirements. Figure 9, Aircraft Maintenance Historical Data, displays an example of the major elements used in the 'Maintenance Analysis Model Program" (MAMS) failure analysis evaluation.

AFM 65-110 STANDARD AEROSPACE VEHICLE AND EQUIPMENT INVENTORY, STATUS, AND UTILIZATION REPORTING

This system provides the status of current inventory and utilization for all aircraft operated by USAF, Air National Guard, Air Force Reserve, and aircraft assigned to commercial contractor facilities (reference 7). Figure 9 also lists total number of flight hours flown, total number of flights for a given timespan for each aircraft.

AFM 127-1 ACCIDENT/INCIDENT DATA

An Emergency Unsatisfactory Materiel Report (EUMR) is submitted upon occurrence of an aircraft accident involving materiel failures. As a result, action is initiated and continues until the cause is determined and corrected to prevent any recurrence.

K051 INCREASED RELIABILITY OF OPERATIONAL SYSTEM

The K051 Increased Reliability of Operational Systems (IROS) Program was developed to identify those components, subsystems, or equipment items that have disproportionate demands on the logistical resources. These items can cause nonavailability or potential safety problems on their reliability or maintainability performances. IROS-generated cost data includes inputs from both the Air Logistics Centers (ALC), also referred to as the depot, and the operational bases.

The elements that make up the system for tracking of logistical support cost are shown in figure 10. The Logistical Support Cost (LSC) includes:

1. FMC - Field Maintenance Cost

2. SRC - Specialized Repair Cost (depot)

3. PSC - Packaging and Shipping Cost

4. CON-C - Condemnations Cost (spares)

TABLE 1. BIRDPROOF TEST COST

Item	Test facility: Goodyear	Test facility: ARO Inc. (AEDC)	Test facility: National Research Council	Remarks
Test fixture				Cost dependant on characteristics of specific config.
Test cell cost Cost/shot	$750			Additional cost for initial setup & reinstallation for test change.
Cost/hour		$170		Rate for Government sponsored programs, incl setup, test & teardown. For other programs, add. indirect cost must be added.
Cost/day			$750	Incl setup & teardown.
Downtime Cost	N R*			Negotiated rate for test support activity.
Cost		N R*		Negotiated rate for separate budget, incl supv labor & inspection. Minimum cost approx $2,500.
Cost/day			$150	Downtime cost reduced to $150/day.
Inerl cost/temp			$200-300	Additional delta cost/shot for temp variation testing
Photo equip.	N R*	N R*	N R*	Additional rental & film costs
Test cell cap Bird size (lb)	4+	10	8	

*Negotiate rate

TECH ORDER MANUALS

- 2 MAINT MANUALS
- 3 REPAIR MANUALS
- 4 ILLUSTRATED PARTS CATALOG
- 6 SCHEDULED INSP & MAINT REQMT
- 06 WORK UNIT CODE MANUAL
- 3M MAINT, MATERIAL & MGMT REPORTS

REPORTS

TRANSPARENCY SUPPLIER DATA

DDC REPORTS

BATTLE DAMAGE REPAIR

AIR FORCE TECHNICAL DATA

MISC REPORTS

Figure 8. Literature Review Sources

WUC	How malfunction code	When discovered code	Action taken code	Units	Time
1114H	190	F	G	6	71.0
		F	A	1	4.0
	846	Q	G	4	17.0
		M	G	1	1.0

- Man hours
- Number of actions
- Minor repair
- Between flights by ground crew
- Cracked
- Windshield panel assy

- Flight hours: 419,294
- Flights: 266,615
- Period: Nov 70 - Nov 71
  Jan 76 - Jan 77

Example

WUC series	Subsystem
111xx	Windshield & windows
122xx	Canopy or enclosure
16xxx	Windshield & hatch
41xxx	Anti-icing system

Figure 9. Aircraft Maintenance - Historical Data (AFM66-1).

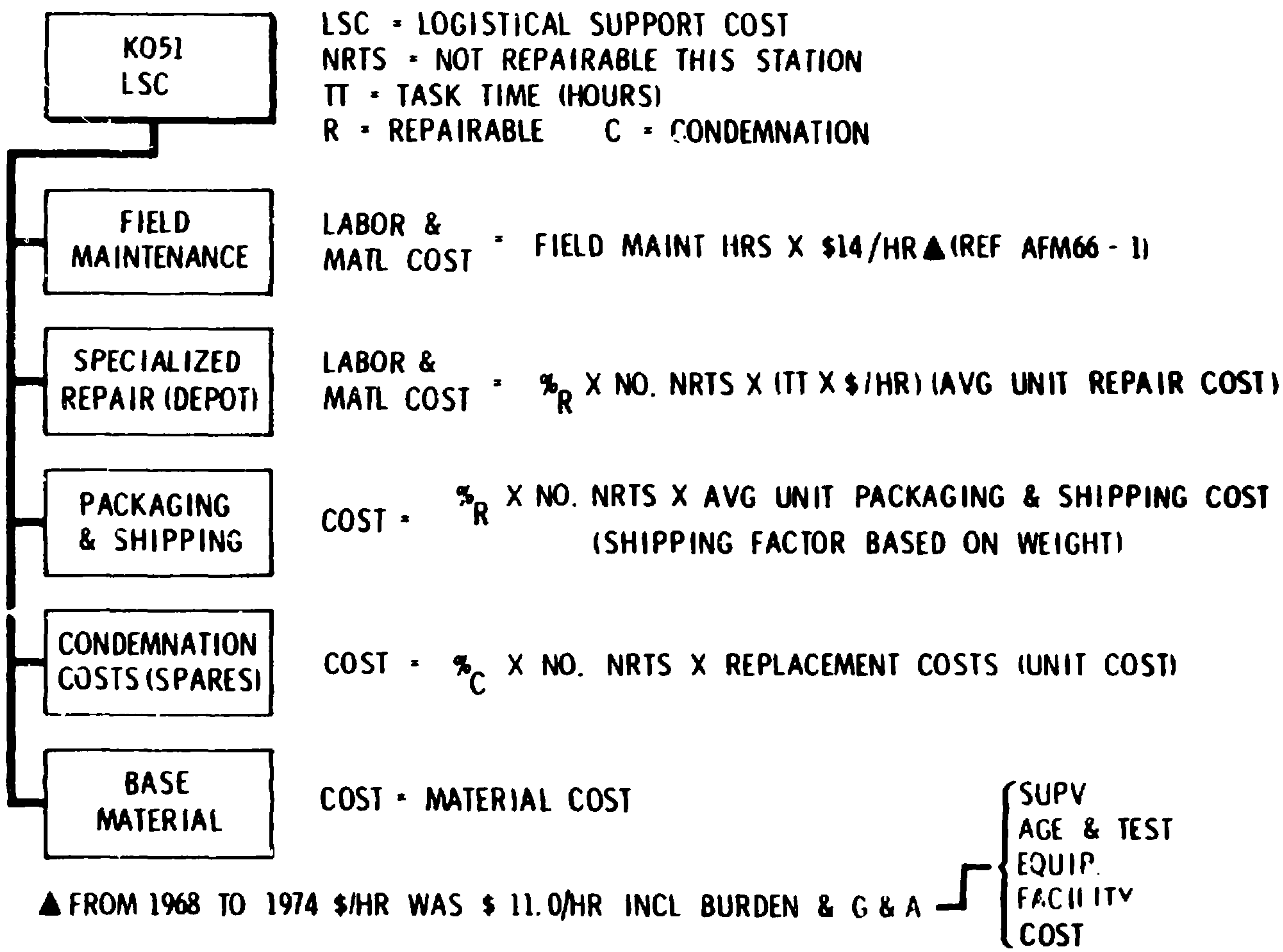


Figure 10. K051 IROS-Improved Reliability Operational System.

SECTION IV

TASK II - AFLC FIELD AUDIT OF PROCEDURES AND COST DATA

FIELD AUDITS

Task II of this program involved the collection of Aircraft Transparency Systems Data from five air logistics centers, eight selected Air Force operational bases, selected aircraft manufacturers, and transparency suppliers. The data and information gathered were obtained by direct visitation to these activities. Table 2 lists the various facilities visited.

Prior to the field audit trip, a generalized questionnaire requesting information about maintenance failure modes, procedures, logistics, and facilities was established. This questionnaire formed the basic line of questioning. Since the program involves the evaluation of 20 different aircraft, additional questions unique to the particular aircraft being reviewed were appended to the general questionnaire. A letter of introduction, suggested agenda, and copies of the questionnaire were sent to the contacts at each facility 2 to 3 weeks prior to visitation to enable preparation and assembly of the required data.

The visits to both the ALC's and OAFB's entailed the collection of information relating to available facilities, maintenance programs, procedures and equipment, test fixtures, etc, for transparency systems. The results of these inquiries are assembled in the installation and maintenance procedures subsection of Section IV.

During each field audit trip, each member of the field audit team took notes on the comments obtained at the review meetings and shop tours. At the conclusion of the review a composite listing of these comments, notes, and suggestions was assembled. The intent of this listing was to supplement the general maintenance and logistical data that was extracted from the AFM 66-1 tracking system.

TABLE 2. SUMMARY OF FIELD AUDIT TRIPS

Trip No.	Facility	Data acquisition/purpose
1	Castle AFB, Ca	B-52, C/KC-135
	ALC, Sacramento, Ca	F-105, F-111, FB-111, T-39
	Travis AFB, Ca	C-5, KC-135, C-141
	ALC, Ogden, Ut	F-4
2	ALC, Oklahoma City, Ok	A-7, B-52, C/KC-135
	Mt. Home AFB, Id	F-111
3	ALC, San Antonio, Tx	C-5, C-9, A/T-37, T-38, O-2, OV-10
	Bergstrom AFB, Tx	F-4, C-130, O-2, CH-53, OV-10
	General Dynamics, Tx	F-111, FB-111
4	Northrup Aircraft, Ca	T-38
5	ALC, Warner Robins, Ga	B-57, C-130, C-141, F-15, CH-3 CH-53, UH-1
	Lockheed, Ga.	C-5, C-130, C-141
6	Goodyear Aerospace, Az	Transparency supplier
	Luke AFB, Az	F-4, F-15, CH-3
	Williams AFB, Az	T-38
	Davis Monthan, Az	A-7
7	Swedlow, Ca	Transparency supplier
8	Sierracin, Ca	Transparency supplier
9	Scott, AFB, Il	C-9, T-39
	McDonnell Douglas, Ms	F-4, F-15
	PPG, Al	Transparency supplier
	Texstar, Tx	Transparency supplier
10	March AFB, Ca	B-52, KC-135

METRIC CONVERSION PROGRAMS

None of the facilities visited during the field audit phase indicated any specific activity or programs directed at the incorporation of metric standards. There is, however, an awareness of its eventual implementation.

COST OF TRANSPARENT ENCLOSURES

Information relative to determining the cost of transparent enclosures was collected and the level of effort to fabricate transparencies was documented. From discussions with the ALC, airframe manufacturers, and transparency suppliers, relative costs in terms of percentages of fabrication effort, labor, and material were assembled. A composite tabulation (table 3) of these relative costs that may be used for estimating purposes are listed below.

TABLE 3. CURRENT COST ESTIMATES FOR TRANSPARENCIES

Configuration	% Labor	% Material
General	50	50
Glass	60	40
Plastic	30	70
Composite plastic	50-60	50-40
Five-year projection	80	20

The costs for transparent components as collected during this program are assembled in Appendix A, the Master Transparency List. These costs are mainly those acquired from the National Stock Number cataloging system to maintain consistency in source of costs. In some cases, where there appeared to be some discrepancy, limited cost data was substituted.

INSTALLATION AND MAINTENANCE PROCEDURES

The installation and maintenance procedures assembled herein are the results obtained from the field audit of the five Air Logistics Centers and eight selected operational Air Force Bases. These audits were made to survey and determine the facilities and maintenance procedures being used to support the maintenance of the transparency systems of the selected 20 study aircraft.

The findings, as listed in the remaining parts of this section, represent a combination of data obtained directly from maintenance personnel and from data extracted from the AFM 66-1 MDCS (Maintenance Data Collection System). During the analysis and evaluation phase that followed the Task II field audit, data that were not made available or were not fully presented to the audit team were supplemented from AFM 66-1 data tapes.

PREVENTIVE MAINTENANCE PROCEDURES

The principal means of malfunction prevention at the operational base level is achieved through surveillance by flight crews and through required periodic inspection by ground crews as specified in the -6 technical manual (Scheduled Inspection and Maintenance Requirements); another means used is the BLIS (Base Level Inquiry System) report. The BLIS report is the equivalent of the AFM 66-1 tracking system used by all Air Force operational bases in accordance with Air Force Manual 171-114, Volume I, and Maintenance Data Collection Report No. 66-267.

The PDM (Programmed Depot Maintenance) program is established in conjunction with the AFLC and the using command. The program designates the level of maintenance activity based on the availability of skills level and facility capabilities. A concurrent ACI (Analytical Condition Inspection) reviews selected components of system elements not normally covered by requirements of the -6 inspection manual. An example is the inspection for fatigue damage in structural components. The data on the condition of the selected structural elements were recorded and are available when the structural item is reinspected at the end of an approximate 3-year cycle.

SEALANT AND AERODYNAMIC SMOOTHING REQUIREMENTS

The requirements for transparency edge sealing and aerodynamic smoothing are listed in Table 4.

ELECTRICAL SYSTEM CHECKOUT PROCEDURES

A reported indication of possible malfunction of the electrical system is generally checked through the use of an AN/PSM-6 (or equivalent) multimeter (FSN 6625-724-8582). The purpose of this test is to determine the magnitude of load resistance or voltage drop for appropriate wiring segments and connectors as specified in the technical order or obtained from experience level established from checks of other aircraft in the operational fleet. Depending on the type of electrical system, the connectors, terminal board strips, circuit board connectors, and plugs are visually and manually checked to assure proper contact. Windshield sensing elements are essentially checked in the same manner. Windshield controllers are generally checked with a windshield control system tester device whose type, operational checkout, and test instructions are specified in the -2 maintenance technical manual. An electrical check is made of the anti-icing system following transparency maintenance and/or replacement.

The following are some of the problems related to the checkout of electrical anti-icing systems collected during the field audit.

COMMENTS

Castle Air Force Base (KC-135)

A single failure was reported (July 1977) due to an open circuit on the windshield anti-icing system.

TABLE 4. SEALANT AND AERODYNAMIC SMOOTHING REQUIREMENTS

Aircraft model	Edge sealant	Aero smoothing sealant	Component Replacement Freq*
B-52	Yes	Yes	987
B-57	Yes	Yes	295
FB-111	Yes	Yes	105
A-7	Yes	Yes	505
A-37	Yes	-	175
C-5	Yes	Yes	90
C-9	Dry	Yes	93
C-130	Yes	Yes	1,386
C/KC-135	Yes	Yes	4,177
C-141	Yes	Yes	944
F-4	Yes	Yes	1,124
F-15	Yes	Yes	131
F-105	Yes	Yes	202
F-111	Yes	Yes	314
T-37	Yes	-	917
T-38	Dry	Yes	315
T-39	Yes	Yes	556
O-2	Yes	No	275
OV-10	Yes	Yes	93
CH-3	Dry	Yes	69
CH-53	Yes	Yes	118
UH-1	Yes	-	389

*Transparency system components replaced in 18-month period.

Travis Air Force Base (C-141)

Maintenance personnel report they found the C-141 T.O.'s were not clear in all areas of windshield/window repair or replacement; for this reason, they utilize the C-5 manuals which are considered to be more comprehensive. Failure of C-5 or C-141 windshields may be operationally related. One possible reason for failure is due to incorrect hookup of the power transformers to the various electrical leads to the windshield panel.

Scott Air Force Base (T-39)

When an anti-icing system is checked out, a voltage and current tester unit is used to monitor the power output of the two ac generators. The major problem with the controller is that the unit's function is out of the over-temperature and undertemperature range, resulting in a false indication. Access to the controller for checkout is extremely difficult. Removal and replacement of this item requires one man 2-1/2 to 3 hours. After reinstallation of windshield, the anti-icing system checkout requires four men 2 to 2-1/2 hours, with an intermittent requirement for operation of the engines.

Scott Air Force Base (C-9)

The principal complaint with the C-9 windshield anti-icing system is the overtemperature and undertemperature indication. The temperature indication gives a readout less than actual temperature that generally causes cracking and shattering of the windshield's outer ply.

CHECKOUT PROCEDURES FOR MECHANISMS OF OPERABLE WINDOWS

A functional check accomplished by the ground crew during the preflight operation is the principal checkout procedure utilized for the mechanisms of operable windows. Formal inspection of this mechanism is also accomplished during the phased inspection as specified in the -6 inspection requirements.

When functional checks are made, the ground crew looks for ease of operation, inspects for worn parts and hardware, and for corrosion. If adjustment or replacement of worn parts is deemed necessary, the organizational Maintenance Squadron (flight line crew) generally makes the necessary repairs.

When replacement of a sliding panel is required, the repairs of the mechanism will revert to the Aero Repair Shop of the Field Maintenance Squadron. Removal and replacement of a sliding window involves frame matching and rigging processes to ensure sealing and window operation. The procedure may vary from one base to another, depending on how the maintenance activities are structured at a particular base.

The following are some of the problems pertaining to the maintenance of the mechanisms of operable windows collected during the field audit.

COMMENTS

Castle Air Force Base (KC-135)

The sliding window replacements are received as an assembly from the depot. Due to the complexity of the frame and sliding mechanism, repair and buildup are not accomplished at base level. The maintenance consists of fitting, adapting, and rigging to the window frame. No particular problems are associated with replacement and reinstallation. Three sliding windows were replaced during the last 3 months ending July 1977.

OC-ALC (KC-135)

The No. 1 (windshield) and No. 2 (sliding window) are sent to a repair subcontractor, when replacement of a transparent is necessary. Of all the transparent panels in the aircraft, the No. 1, 2, and 3 windshield panels are the most difficult to replace.

Mountain Home Air Force Base (F-111)

The repair/replacement of the hatch assembly panel is the most costly maintenance action. Approximately 30 man-hours during a 24-hour period are expended. An additional 15 to 20 hours for painting and for egress people to install, adjust, and check out are required.

SA-ALC (T-38)

The loss of canopies, primarily the forward canopy, has resulted in the issuance of TCTO No. 942. The TCTO was published due to finding many canopies incorrectly rigged and the thruster hose improperly positioned. The latching mechanism adjustments are very critical in this enclosure installation and are comprehensively covered in TCTO No. 942. Failure to follow the prescribed maintenance T.O.'s by field personnel was the main cause of the difficulty encountered in rigging the canopy mechanisms. The depot has reviewed the instructional data and deemed it adequate to cover all field installation requirements.

SA-ALC (T-37)

No problems with the canopy lifting mechanism are currently being reported. Some time ago (time period not specified), the locking mechanism was binding with some interference noted. A TCTO was issued (number not identified) that included a revision in the rigging procedure. The rerigging procedure has apparently cured the problem.

Bergstrom Air Force Base (OV-10)

A number of side panel failures (in-flight losses) have been reported that were caused due to failure to either lock the panels prior to takeoff roll or failure of the latch mechanism to ensure that both front and aft panels would lock properly. Worn bushings in the side panel latch mechanism

are the problem attributed to loss during takeoff or flight. Maintenance personnel consider this normal wear and tear with replacement of the bushings as the corrective action.

William Air Force Base (T-38)

Reworking of the T-38 canopy latching mechanism was necessitated by spline wear, linkage damage, etc. Removal, repotting, reinstallation, and rerigging require 1 to 7 hours depending on the number of parts removed. The time required to cure the epoxy potting may require as many as 18 hours.

CORROSION PREVENTION

Numerous technical manuals for corrosion control and maintenance manuals for the prevention, detection, and treatment of each aircraft type are utilized by the using command and the Air Logistics Centers. The detailed description of the techniques and procedures used in the control and prevention of corrosion is beyond the scope of this study; however, a generalized description as assembled from the field audit is presented.

Corrosion prevention is achieved by periodic cleaning to remove corrosive agents which are continually deposited on metallic surfaces. Means of protecting these surfaces are by frequent cleaning, polishing, and waxing. Early detection of the formation of corrosion, principally by visual inspection, is considered to be the most effective preventive measure. Dye penetrant inspection is used to find cracks, in the covered area of faying surfaces that may be prone to stress corrosion. The rule of thumb used for grinding the corroded surface is limited to 10 percent of the material thickness. Grinding that exceeds 10 percent requires the replacement of the damaged member. The final action required is the application of the proper primer and protective coating.

The following are some of the problems related to corrosion of transparency components as collected during the field audit.

COMMENTS

Castle Air Force Base (B-52, KC-135)

Corrosion-related problems of both the transparency and supporting structure are reported to be negligible.

OO-ALC (F-4)

The four magnesium castings at the lower ends of the forward canopy are sometimes replaced because of corrosion. Other parts that are susceptible are the forward canopy arch and the windshield defogging nozzle. The nozzle, made from magnesium, is susceptible to corrosion because of its location. Rain and moisture collection can flow into the part and, although it has a moisture drain hole, it has a high replacement rate.

OL-ALC (A-7)

Corrosion is sometimes experienced in the canopy frame that doubles as a hot air defogging duct and diffuser. The parts mostly subject to corrosion are made of magnesium. Significant reductions in corrosion were accomplished by replacement with aluminum alloy.

Mountain Home Air Force Base (F-111)

Corrosion is a negligible problem at this base. Each aircraft is washed and scrubbed every 60 days.

SA-ALC (T-38)

Corrosion of the enclosure frames and support structure, when detected (especially aircraft stationed at coastal bases), is cleaned in accordance with procedures in the -3 repair manual.

Bergstrom Air Force Base (F-4, C-130, CH-53, T-38)

Transparency corrosion problems at this base are considered to be negligible. The F-4's operating with the 67th TRW have the canopies washed and the canopy frames waxed daily and/or before each flight. When window replacement for the CH-53 is required, a corrosion preventive compound (zinc chromate) is applied between glass and frame.

WR-ALC (C-130)

The windshield post (extruded member) between the forward windshield and clear vision window has been subject to cracking. The cause for this cracking is attributed (a) to intergranular corrosion resulting from the machining of the web, exposing the short transverse grain, and (b) from bending stress induced from fastener attachment.

Luke Air Force Base (F-15)

In general, transparency corrosion problems for this aircraft are considered to be negligible. Some corrosion has been detected on the longeron sills.

Scott Air Force Base (C-9)

Transparency support structure is relatively free of corrosion. Some corrosion of the screwheads has been detected.

REFURBISHMENT PROCEDURES

The refurbishment of windows and enclosures by maintenance people at the base level adheres to the procedures and tools as specified in the structural repair manual. In most cases, flight crews initiate the request for repair.

Part of the Quality Control (Q/C) evaluation is the decision to refurbish or replace. This decision is based upon detailed information on scratches and bubbles and an assessment of deterioration of optical qualities in the critical viewing area. The optical micrometer is widely used to acquire the detailed information. Depending on the type of construction and material various polishing and buffing kits are available to refurbish transparency components.

The following are some of the comments relating to the refurbishment procedures that were collected during the field audit.

COMMENTS

Castle Air Force Base (B-52, KC-135)

The detection and evaluation of the size of bubbles, scratches, chips, and :tent of panel delamination is aided by the use of a flashlight and a ten-times magnifying glass.

Travis Air Force Base (C-5, KC-135, C-141)

For panels that have light scratches a special polishing kit is used. Transparency Repair and Reclamation (R&R) crews stated that they have had a great deal of success in buffing and polishing this type blemish. The type kit used is:

Polysand Windshield Maintenance Kit in accordance with MIL-M-5809-1a, No. 1560-00-450-3622 (1) Kit DAAJ0177D-0013-0001

OO-ALC (F-4)

The transparency shop, principally dedicated to the rework of F-4 windshields and canopies, has a section set aside where minor scratches and abrasions are polished and smoothed out. Canopies sent to the depot are not

automatically replaced. If scratches are found to be within T.O. limits, they are polished, refurbished, and returned to spares.

OC-ALC (B-52)

The only B-52 windshield window refurbished by polishing is the eyebrow window.

Mountain Home Air Force Base (F-111)

Refurbishment of transparent assemblies is accomplished in the structural repair shop. An oven is utilized to cure sealant when a transparent panel is replaced. Controlled temperature of this oven is difficult to maintain.

Bergstrom Air Force Base (F-4)

Scratches that can be removed are sometimes polished with toothpaste. Maintenance people claim good results. They also refer to the rubbing and polishing techniques as described in the Navy publication, "Life Line Magazine."

Bergstrom Air Force Base (CH-53)

Scratches are not polished or buffed. When they become objectionable to flight crews, the windows are replaced.

Luke Air Force Base (F-15)

The transparency maintenance function at this base is primarily "remove and replace" with minor repairs limited to polishing of acrylics. Due to the lack of required skilled personnel, canopy polishing and buffing of coated

polycarbonate components are not accomplished at this base. Canopies are sent to the depot for this type of refurbishment.

Luke Air Force Base (H-3)

Experience with H-3 windshields indicates that the polishing and buffing operation is a temporary fix at best as these windshields have to be replaced in a short period of time.

Williams Air Force Base (T-38)

This base has been very successful in polishing and buffing small scratches. Upon completion of this operation, one or more pilots are enlisted to check optical qualities.

Davis-Monthan Air Force Base (A-7)

The buffing and polishing of scratched windshield side panels takes about 4-1/2 to 5 hours. The Q/C officer or pilot checks the repaired area for questionable distortion; if it is not acceptable, the transparency in question is replaced.

DESCRIPTION OF MAINTENANCE FACILITIES

The maintenance and repair facilities of all of the operational bases and Air Logistics Centers visited by the field audit team are considered to include good under-roof and hangared areas, adequate equipment, and staffed with very good personnel for the servicing of both aircraft and transparency systems. The servicing of transparency systems for the wide variety of operational aircraft is accomplished in both the ramp and the hangared areas.

The under-roof maintenance accomplished at the base level is generally reserved for heavy duty maintenance such as engine change, landing gear rework, structural modification, etc. Consequently, the "on-aircraft" maintenance of transparency systems is frequently (weather permitting) accomplished on the ramp or flight line. The "off-aircraft" maintenance is action that requires servicing in specialized shops.

Since the transparent components, windshields, canopies, and windows, are considered to be an integral part of the basic airframe, transparency repairs are performed in the structures shop. When a high rate of transparency repair is required, a dedicated plastics transparency shop is utilized.

The maintenance at depot level is oriented to a programed production-type activity referred to as PDM (Programmed Depot Maintenance). The PDM may include simultaneous modification, TCTO (Time Compliance Tech Order) rework, and general maintenance. During the audit of the Sacramento Air Logistics Center, the F-111 series aircraft were being modified for the incorporation of birdproofed windshields and hatches. Due to the extensive maintenance accomplished, nearly all of this effort is in a hangar facility.

When the repairs required for a transparency system exceed the capability at the base level, the depot provides a dedicated plastic shop to support these maintenance demands. These shops are staffed with specialized personnel and include tooling to make the necessary transparent panel replacement or to refurbish and service the total system.

Table 5 is a summary of the transparency system repair facilities surveyed by the Rockwell field audit team.

LEVEL OF TRANSPARENCY CAPABILITY

The level of transparency maintenance capability for both the logistics centers and the operational bases can best be described by relating to the structure of each type of organization. Figures 11 and 12 depict the principal

TABLE 5. SUMMARY OF TRANSPARENCY SYSTEM MAINTENANCE AND REPAIR FACILITIES

Facility	Type underroof facility	Maint accomp on ramp in hangar	Dedicated plastics transparency shop
A/F Logistics Command			
SA-ALC, San Antonio	Major	Hangar	Yes
SM-ALC, Sacramento	Major	Hangar	Yes
OO-ALC, Ogden	Major	Hangar	Yes
OC-ALC, Oklahoma City	Major	Hangar	Yes
WR-ALC, Warner Robins	Major	Hangar	Yes
A/F Operational Base			
Bergstrom	Opertl	Both	No
Castle	Major	Both	Yes
Davis Monthan	Opertl	Both	No
Luke	Opertl	Both	Yes
Mountain Home	Opertl	Both	Yes
Scott	Major	Hangar	Yes
Travis	Major	Both	Yes
Williams	Opertl	Both	Yes

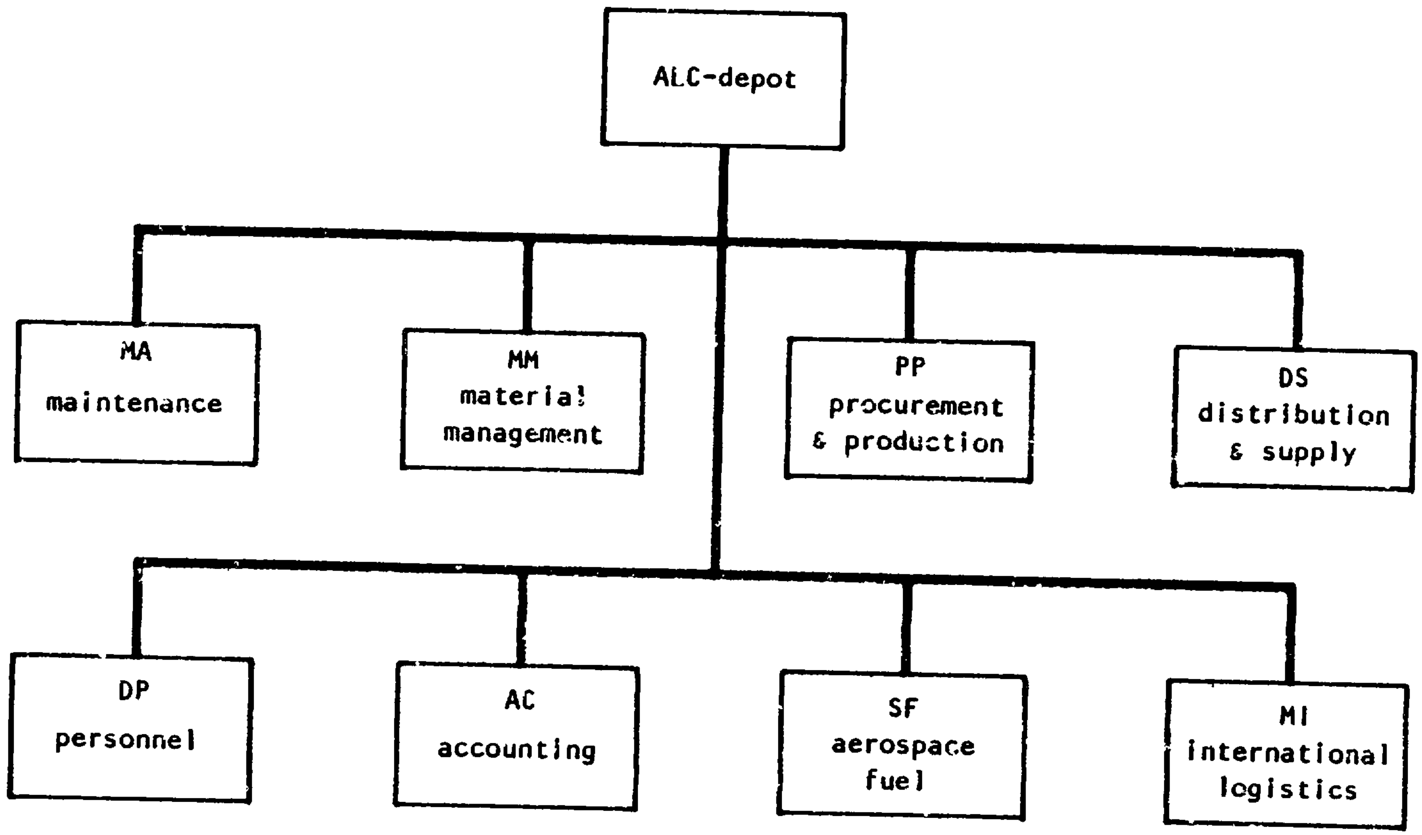


Figure 11. Air Logistics Center Directorate.

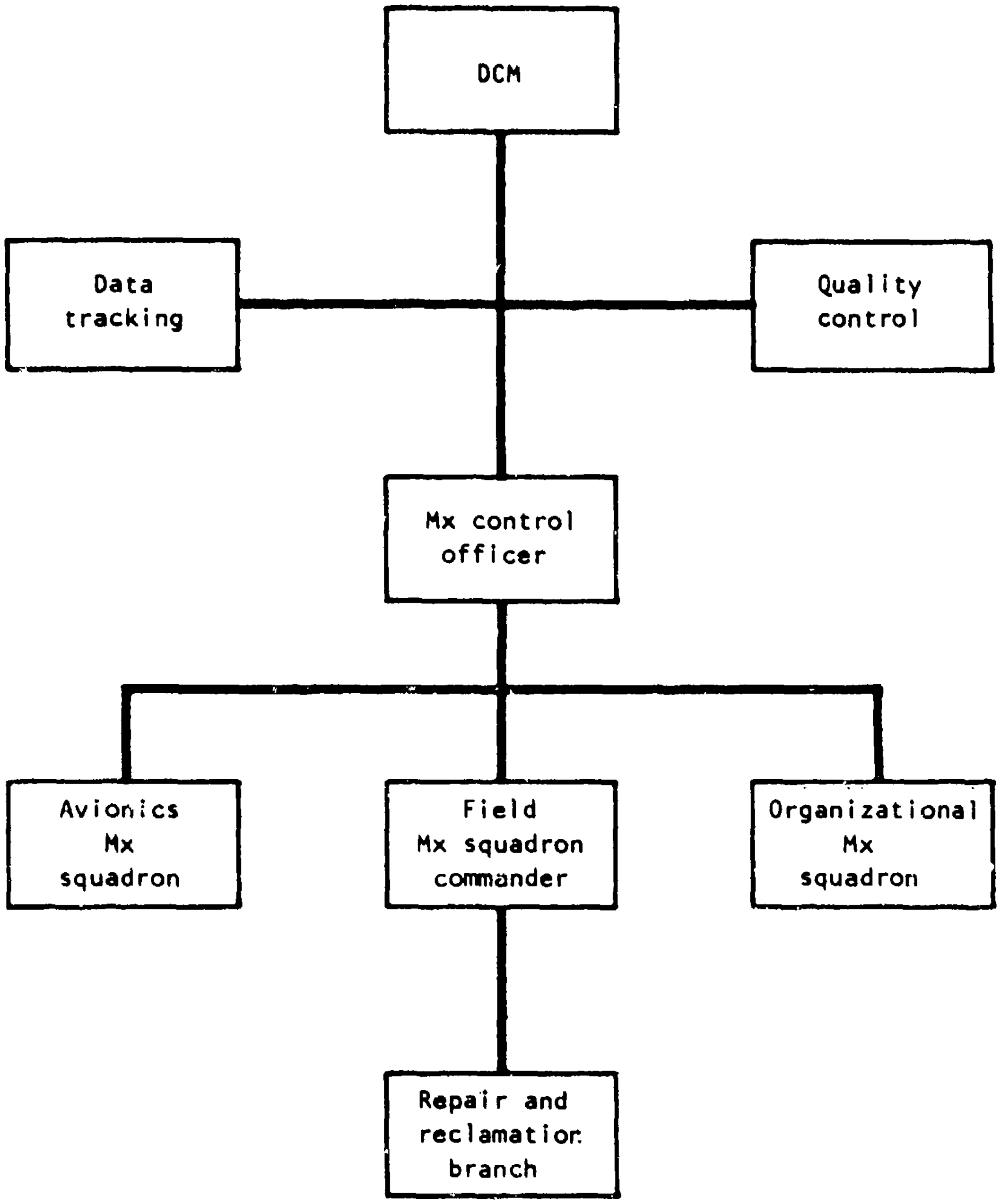


Figure 12. Base Level Maintenance

breakdown of the functions from which transparency data were gathered during the Task II field audit phase.

In the view of the field audit team the Air Logistics Centers (figure 11) provide the following capabilities:

1. The general overhaul and modification of aircraft systems and components. An example of this type of modification from a transparency standpoint is the complete replacement of F-111 and F-15 windshields and enclosures at Sacramento and Warner Robins Air Logistic Centers, respectively.

2. Specialized repairs of transparency components and interactive subsystem units that cannot be serviced at the base level.

3. The procurement of replacement parts and spares to ensure availability to support scheduled maintenance for minimum downtime, to keep these aircraft in combat or service readiness.

4. Special services such as technical support, maintenance task teams, instructional publications and training procedures, and training aids.

Most of the actual maintenance history of the selected study aircraft was obtained from the MM (Materiel Management) people. The discussion on maintenance problems included system and item managers and equipment specialists. Data requests concerning spares and logistical costs were directed to PP (Procurement and Production) and DS (Distribution and Supply) personnel. Supervisory people from MA (Maintenance) Division provided tours to facilities and provided information on the maintenance procedures and equipment as used at the respective Air Logistics Centers.

The maintenance at the base level is generally structured about the Field Maintenance Squadron (FMS) organization. Figure 12 shows the principal levels of command and services provided in support of the operational units. The services and functions of base level maintenance are:

1. General flight line maintenance, provided by the OMS (Organizational Maintenance Squadron). This type maintenance, such as adjustments and minor rework, is accomplished in support of the preflight and postflight activity.

2. Removal, repair, and replacement of transparency components. The RRS (Repair and Reclamation Shop), frequently referred to as the Aero Repair Shop, is generally responsible for the removal, repair, and replacement of transparency components.

3. Servicing of electronic (black box) type devices and attendant systems. The AMS (Avionics Maintenance Squadron) is responsible for maintaining electrically powered anti-icing system components in addition to servicing electronic-type devices.

4. Quality Control (Q/C). This function is charged with ensuring conformance with technical manual requirements and to assure proper maintenance workmanship.

5. Implementation of the BLIS (Base Level Inquiry System) program that provides the means of tracking and recording the base maintenance activity. This system extracts maintenance information as inputed to the AFM 66-1 MDCS through AFTO-349 and -350 maintenance data collection record forms. Data from these forms are keypunched into the BLIS computer program to provide a printout of base maintenance activity. Statistical data people are responsible for accomplishing this task.

Most of the base operations surveyed are structured about the FMS concept. A new concept, POMO (Production Oriented Maintenance Organization), is in the process of being introduced to maintenance operations. POMO appears to be similar in functional support, but is directed towards providing greater flexibility in the utilization of maintenance personnel to achieve quicker turnaround time and shorter downtime.

The review of training activity at all the bases visited indicates that "on the job training" was the principal mode of providing transparency maintenance capability. The closest form of specialized training is the exchange of personnel on temporary duty assignment from depots to bases to support unique problem areas. Additional means of specialized training are from field representatives of the airframe manufacturers.

MAINTENANCE/REPAIR WORK BREAKDOWN STRUCTURE

The Work Breakdown Structure (WBS), as defined in MIL-STD-881A (reference 13), is a product-oriented family tree composed of hardware, services, and data which result from Project Engineering efforts during the development of a defense material item and which completely defines the project/program. A WBS displays and defines the product(s) to be developed or produced and relates the elements of work to be accomplished to each other and to the end product.

If the intent is to apply the usage of WBS to maintenance and repair as an adjunct to the AFM 66-1 maintenance data collection system the generic WBS as shown in figure 13 may be considered. For this purpose the WBS is first tasked to the mainline maintenance actions and, secondly, tiered to represent the various levels to provide adequate definitions of the transparency components and interactive subsystems. The identification codes, as shown in these charts, are the normally utilized method. The work unit code system may be substituted if desired.

ALC STORAGE PROCEDURES

The procurement and production directorate of the Air Logistics Centers has the responsiblity of procuring, stocking, and maintaining the inventory of

Reference 13. Department of Defense, Military Standard, "Work Breakdown Structures for Defense Materiel Items," MIL-STD-881A, Headquarters, Air Force Systems Command, Directorate Cost Analysis, Andrews Air Force Base, DC 20334, 25 April 1975

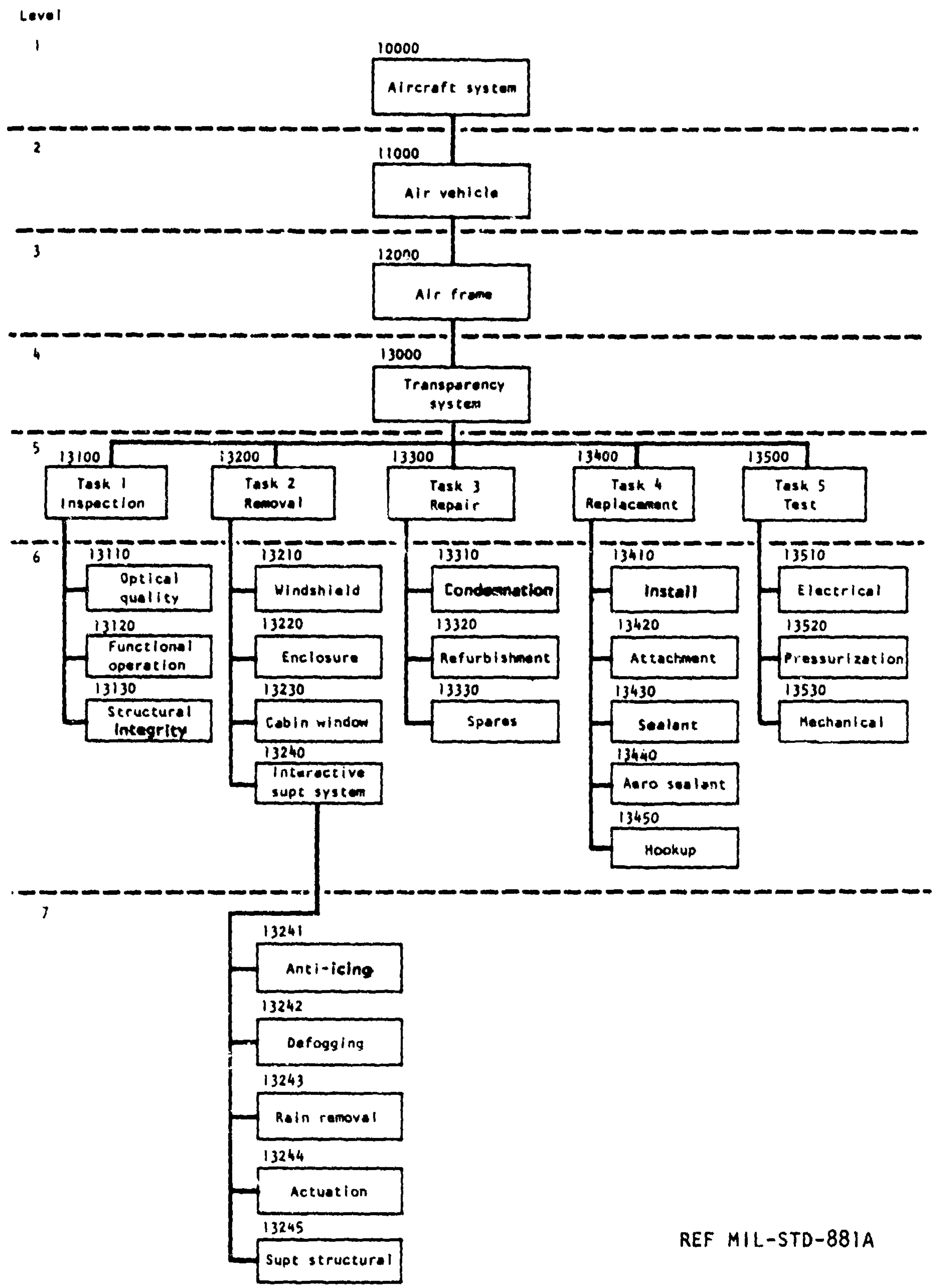


Figure 13. Maintenance/Repair - Work Breakdown Structure (Level 1-7).

spare parts required to support ALC's and operational bases. The procedure for the determination of the number of spare parts is as noted in a later paragraph. The transparency spare parts generally consist of the principal transparency components (windshields, window, canopies) and anti-icing system controllers. Other spares stored for the interactive support system are parts whose demand rate exceeds the 6-month processing period.

The following are some of the comments relating to the storage procedures that were collected during the field audit.

COMMENTS

SM-ALC

The Item Manager is responsible for tracking the line replaceable units (LRU). He records part and federal stock numbers, and assembles logistical support data.

OO-ALC

The D062 spares requirement system tracks on a bimonthly basis and covers projection for a 2-year timespan. Limited and specialized maintenance repairs and replacements are reported to the AFM 66-1 network.

OC-ALC (A-7)

The depot does not manage spares for the A-7 aircraft. Transparency spares are provided by the Navy. The depot replaces on an as-required basis and can generally get replacement parts within 24 hours with a priority request from stock or the transparency vendors.

SA-ALC (T-38)

Spares are stock number stored and issued as required. Spares for Air Force and NATO are ordered through SA-ALC. However, some NATO countries order directly from the aircraft manufacturer.

WR-ALC (F-15)

The modified transparencies from the manufacturer are stored at Warner Robins. When a request for spares is received from an operational unit, the replacement is pulled from storage and shipped to the requesting base. Damaged canopies are returned to the depot for salvage disposition.

PACKAGING AND SPECIAL HANDLING PROCEDURES

The packaging for the transparency components (windshields, windows, canopies) consists of plywood and cardboard containers. The specifics regarding sealing and handling are in conformance with MIL-STD-794D (Procedures for Packaging of Parts and Equipment). Many of the crates used for canopies showed signs of considerable aging and were missing the protective felt parts. It appears that an inspection procedure for the larger and more costly containers should be established to ensure proper carriage of costly components.

Hand handling of transparency panels and canopies was by far the most popular means for installation. This comment applies to the handling of large size components. When adequate scaffolding and maintenance platforms are available, the preference is to handle large panels by two people. When access to the repair areas is difficult, reliance on cranes, slings, and holding fixtures is accepted.

The following are some of the comments relating to the packaging and handling procedures collected during the field audit.

COMMENTS

Castle Air Force Base (B-52, KC-135)

No specialized equipment, special tools, or special fixtures other than equipment available for general maintenance are utilized for transparency components.

Travis Air Force Base (C-5, KC-135)

Special slings for handling of windshield panels are available. This device is seldom used; man handling is easier and quicker when removing and reinstalling panels. The maintenance crew has improvised a special handling kit consisting of suction-type handles, alignment pins, and wingnut devices for pulling the windshield into position, to achieve the desired seal.

OO-ALC (F-4)

Because of very close tolerances involved in the installation of an F-4 canopy assembly, a special rigging fixture is utilized to assure proper alignment of the forward area, glass and frame assembly. Two fixtures, for the forward and aft canopies, fabricated from McDonnell Douglas specifications, were built at a cost of 26,000 dollars each. A principal modification to these fixtures is the alignment device used for the forward arch frame.

Many of the canopies (Plexiglas) are found to be extremely difficult to install to the frames due to their being spread out of tolerance. Some can be forced into place while others must be re-formed after heating to approximately 125°F.

Packaging and handling of transparency assemblies are accomplished through the use of reusable plywood containers. Many of the shipping containers for the canopies are in poor condition and are warped. It is recommended that these either be repaired or condemned.

OC-ALC (B-52)

No special maintenance tools or equipment are utilized at this facility.

Luke Air Force Base (F-15)

Packaging and transport - generally adequate; old units are returned to the depot in a reusable container which was used for the replacement transparency.

SA-ALC (C-5A)

A sling and bar are used to hoist the windows up and down during R&R as they are heavy and bulky.

Bergstrom Air Force Base (F-4)

Containers received from the depot quite frequently deteriorate. They suggest, because of the cost of the contained canopy, that a more durable packaging crate should be used.

QUALITY CONTROL AND NONDESTRUCTIVE INSPECTION PROCEDURES

The Quality Control (Q/C) procedures as observed by the field audit team appeared to be similar at both the Air Logistics Centers and operational bases. The methods of inspection were basically in accordance with the phasing concepts and isochronal concepts as specified in the -6 technical manual, "Scheduled Inspection and Maintenance Requirements."

The nondestructive inspection procedures utilized are principally visual for the transparency components. However, some dye penetrant testing for the transparency support structure is performed in addition to visual inspection. The structural repair shops at the Air Logistics Centers expressed some interest in utilizing other means of nondestructive inspection methods.

The following are some of the comments relating to quality control and nondestructive inspection procedures collected the field audit.

COMMENTS

OO-ALC (F-4)

No special Q/C methods are utilized for transparency system inspection. Q/C for transparencies are under "Sheet Metal" inspection. The only Q/C checks made in the plastic shops are to check the fit in the assembly fixture, and only on a random basis.

OC-ALC (KC-135, B-52)

Nondestructive inspection techniques utilizing sonics as a means of transparency inspection are being considered. To date, no firm programs or action for inclusion of this means of inspection are in work.

Bergstrom Air Force Base (F-4, OV-10)

General Q/C procedures are used at this base with principal reliance on visual methods.

Northrop Aircraft Corporation (T-38)

A more systematic process for the inspection of optical qualities should be developed. A procedure utilizing a laser device would minimize the

judgmental aspects that are currently being used. This method would be particularly useful in the marginal areas of transparency quality. The decision to accept or reject a part is often made by a pilot.

Swedlow Incorporated

Feedback from test pilots regarding the optical qualities of UH-1 helicopters are overspecified and too stringent. Not really required.

Scott Air Force Base

Dye penetrant is the NDI means of checking for cracks of transparency frames and support structure.

PROCEDURE FOR DETERMINING NUMBER OF SPARE PARTS

The level of spares is based on the number of aircraft systems and the consumption rates for a 6-month period. The period specified dictates the number of spares to be stocked. If the consumption exceeds spares on hand, the number of spares are readjusted for the following period. A special level assignment will provide a minimum number (generally two spares) regardless of the number of aircraft or consumption rate during the 6-month period. A table of allowances (Master Supply List) establishes the number of spares.

If a reorder of a transparency component is required from the depot, a leadtime of 6 months is generally required. An allowance of [illegible] days is generally required to resupply from the depot. Maintenance actions or repairs are accomplished on a priority basis during excessive workload periods. The assignment of priority is as follows:

Priority Request	1-4
Top Priority	1
Lowest for Maintenance	4
Supply Range	1-15
Normal Supply	12

MAINTENANCE EFFORT

The level of maintenance effort for the man-hours required for removal and replacement repair, and functional test and checkout are listed in table 6. This table summarizes the effort at the aircraft level and consists of maintenance hours, task times, and MTBA and MTBUR for an 18-month timespan from January 1976 through June 1977. These data were processed from AFM 66-1 data tapes utilizing the Reliability and Maintainability (RAM) program.

The details of these maintenance efforts are also summarized to each work unit code, and are contained in Appendix B. In view of the extensive printout of this type of information, one sample for the T-39A is included in Appendix B. The terms and definitions are specified on the first page of the included sample. The most widely used RAM parameters such as mean man-hours per unit, mean man-hours per flight hour, replacement rate, maintenance rate, abort rates, and number of replacements are listed or can be found in the data tabulations.

TABLE 6. AFM 66-1 RELIABILITY AND MAINTAINABILITY DATA

Aircraft Model	Operating Hours	No. Flts Flown	Maint (1) Man-Hours	(2) No. Units	(3) Task Time	(3) MTBMA	MMH per Flt Hr	(3) MTBUR	Replcmt Task Time (3)	Non-Rep Task Time (3)	Grd Abort Rate (4)	Flt Abort Rate (5)
B-52	151,214	54,114	17,343	7,091	2.45	21.32	0.1147	153.21	6.15	1.85	0.000111	0.000026
B-57	19,791	14,495	6,241	1,701	3.67	11.63	0.3153	67.09	3.89	3.62	0.000828	0.000051
FB-111	22,678	12,008	4,396	1,116	3.94	20.32	0.1938	215.98	5.44	3.78	0.000083	0.000088
A-7	153,033	91,129	16,793	2,707	6.20	56.53	0.1097	303.03	5.65	6.33	0.000099	0.000098
A-37	43,829	35,375	3,081	799	3.86	54.85	0.0703	250.45	4.21	3.75	0.000141	0.000023
C-5	60,183	40,325	5,849	1,544	3.79	38.98	0.0972	668.7	10.77	3.36	0.000050	0.000000
C-9	37,238	36,854	2,038	1,283	1.59	29.02	0.0548	400.41	0.26	1.39	0.000000	0.000107
C-130	445,923	472,960	27,779	5,379	5.16	82.90	0.0623	321.73	5.59	5.01	0.000027	0.000049
C/KC-135	283,930	179,705	127,190	88,475	1.44	3.21	0.446	67.97	5.53	1.23	0.000133	0.000095
C-141	399,320	245,916	42,537	8,306	5.12	48.08	0.1065	401.73	8.39	4.67	0.000069	0.000030
F-4	544,562	470,536	81,841	8,458	9.68	64.40	0.2503	484.57	6.92	10.10	0.000145	0.000039
F-15	36,206	33,642	14,908	943	15.81	38.39	0.4118	276.39	8.53	21.18	0.001255	0.000221
F-105	62,043	42,606	7,701	1,187	6.49	52.27	0.1241	307.14	5.11	6.77	0.000164	0.000032
F-111	102,901	53,033	15,057	4,699	3.20	21.90	0.1436	327.71	4.22	2.49	0.001037	0.000078
T-37	413,535	942,661	11,961	3,449	3.47	119.90	0.0290	450.97	2.81	3.70	0.000046	0.000034
T-38	249,221	612,542	20,117	5,541	3.63	44.98	0.0808	791.18	1.91	3.73	0.000072	0.000157
T-39	172,036	207,203	22,795	3,196	7.13	53.83	0.1325	309.42	5.58	7.46	0.000043	0.000134
O-2	108,923	119,439	4,100	1,395	2.94	78.08	0.0376	484.10	4.62	2.62	0.000000	0.000009
OV-10	25,364	24,668	1,954	889	2.20	28.53	0.0771	272.73	3.65	2.03	0.000081	0.000000
CH-3	15,691	35,725	1,546	365	4.24	42.29	0.0986	227.41	6.83	3.61	0.000000	0.000000
CH-53	8,193	16,436	1,928	450	4.28	18.21	0.2353	69.43	5.76	3.76	0.000061	0.000000
UH-1	26,938	59,356	5,774	3,407	1.69	7.91	0.2144	69.25	2.96	1.64	0.000000	0.000149

(1) 18 months timespan 1/76 through 6/77

(2) Denotes the number of units to which action was taken

(3) Time in hours

(4) Number of flights

(5) Number of hours

SECTION V

CONCLUSIONS

The transparency system characteristics as assembled in this volume present a comprehensive array of the various configurations, materials, and methods of construction as utilized in the 20 study aircraft. This data base provided an invaluable tool to aid in the identification of design improvement studies found in Volume III of this report.

The qualification, testing, maintenance, and installation procedures that were collected and assembled in this volume indicate that the operations at both the ALC and Operational Base are accomplished in accordance with established Air Force Regulations and/or Technical Orders. The extent of supplemental procedures utilized by each facility varies with the organizational structure and the amount of aircraft operational activity.

In general, the personnel in the field are well qualified and the facilities for servicing transparency systems are considered adequate.

APPENDIX A

TABLE A1

MASTER TRANSPARENCY SYSTEM LIST

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST
MODEL B-52G/H/F (FG)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11DOO	Forward Fuselage						
11DCR	- Window, No. 2 LH (W/S L & R of center)	10-30347-1	1560-00-512-0731	961.61	2	Cracked	17.5
11DCR	- Window, No. 2 RH	10-30347-2	1560-00-512-0732	966.87			
11DCS	- Window, Eyebrow No. 6 LH	5-52096-5	1560-00-632-2316	514.67	4	Delam.	21.6
11DCS	- Window, Eyebrow No. 6 RH	5-52096-6	1560-00-652-7638	578.66			
11DCS	- Window, Eyebrow No. 7	10-1389-36	1560-00-626-2996	354.42			
11DCT	- Window, Sliding, LH	10-30347-3	1560-00-533-1797	528.86	1	Cracked	13.6
11DCT	- Window, Sliding, RH	10-30347-4	1560-00-612-2865	425.60			
11DC6	- Windshield, No. 1	10-30347-7	1560-00-738-2714	860.63			
11DC7	- Window, No. 4 LH	10-30347-5	1560-00-512-0735	575.98			
11DC7	- Window, No. 4 RH	10-30347-6	1560-00-055-6758	604.55			
11DC8	- Window, No. 5 LH & RH	10-1389-37	1560-00-626-2995	501.11	5	Delam	27.3
11D99	- Noc (1)						
41HXX	Window Anti-icing System						
41HAO	- Controls						
41HAA	- Switch, Pilot Instr Panel						
41HAB	- Control, Window, Anti-ice Temp				3	Internal failure	32.9
41HAC	- Switch, Anti-ice Control						
41HAD	- Amplifier						
41HAE	- Relay, Windshield						
41HAF	- Transformer, Window						
41HAG	- Switch, Windshield Limit						
41H99	- Noc						

(1) Not otherwise coded

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL B-57 (KC)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	$ of MMH
11100	Canopy, Jettisonable, General				1	Crazed	13.5
11111	- Plexiglass, Fwd	272B6000210-119	1560-00-348-837	2,825.00			
11111	- Plexiglass, Aft	272B6000210-129	1560-00-697-9648	2,957.00			
11112	- Hinge						
11114	- Frame						
11115	- Linkage						
11116	- Latch						
11118	- Seal	272B6000219	1560-00-692-1264	139.00			
11150	- Windshield Components						
11151	- Panel, RH W/S Side	272B6000178-4	1560-00-336-1974	160.82			
11152	- Panel, LH W/S Side	272B6000178-3	1560-00-336-1973	274.13			
11153	- Panel, W/S Frt	272B6000177-	1560-00-339-7493	643.07	3	Scored or scratched	31.5
11154	- Frame						
11199	- Noc						
41300	W/S, Anti-ice System						
41310	- Mechanical Components						
41311	- Duct				4	Bent, buckied, collasp.	14.9
41312	- Nozzle						
41320	- Electrical Components						
41322	- Valve, Hot Air						
41323	- Element, Temperature						
41324	- Box, Control						
41325	- Sensing Element						
41326	- Valve, Shutoff, Modult'g						
41399	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL B-57 (KC)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
41200	W/S, Defogging & Recirculat'g						
41220	- Electrical Components						
41221	- Blower, Recirculating				5	Bearing failure	27.0
41224	- Valve, Control				2	Loose, dmgd bolts, nuts	36.6
41227	- Control Box, Temp						
41228	- Selector						
41229	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL F/FB-111A/D/E/F (BJ)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
16000	Escape Capsule, Crew Module Windshield Assembly						
16AAB	- Fairing, W/S Inst, RH & LH	12K3206-21 & -22					
16AAC	- W/S, Glass, LH	17-17683-855	1560-00-178-8766	18,019.00	5	Prot coat/ sealant def	20.8
16AAC	- W/S, Polycarbonate, LH	NP-113201-101-1	1560-00-605-4890	15,340.00			
16AAD	- W/S, Glass, RH	17-17683-856	1560-00-178-8768	18,019.00	3	Prot coat/ sealant def	9.4
16AAD	- W/S, Polycarbonate RH	NP-113201-301-1	1560-00-605-48	15,340.00			
	Hatch Installation						
16ABA	- Hatch Assy, LH	12K3070-823	1560-00-110-6957				
16ABD	- Hatch, Glass, LH	17-17684-841	1560-00-131-9170	18,587.00	1	Delam	28.8
16ABD	- Hatch, Polycarbonate, LH	NP-113202-501	1560-00-605-5224	10,774.00			
16ABE	- Hatch, Glass, RH	17-17684-842	1560-00-131-9171	18,587.00			
16ABE	- Hatch, Polycarbonate, RH	NP-113202-502	1560-00-605-5226	10,774.00			
16ABF	- Frame, LH and RH	12K3052-801 & 805					
16ABG	- Hatch Assy, RH	12K3070-824	1560-00-110-6958				
16ABH	- Seal, Rain	12K3070-17	5330-01-004-3645	17.45			
16ABJ	- Seal, Pressure	4C1167	1560-00-853-7008	228.55			
16AB9	- Noc						
41000	Air Conditioning, Pressurization, Sur. Ice Control						
41CA0	- Rain Removal & Anti-icing						
41CAA	- Valve, Contl Hot Air Temp				4	Intnl failure	48.6

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL F/FB-111A/D/E/F (BJ)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
41CAB	- Sensor, Hot Air Temp				2	Adjmt/ impropr align.	12.5
41CAC	- Valve, Regult'g, Hot Air Press.						
41CAD	- Switch, W/S Overheat						
41CAE	- Valve, Rain Removal Shutoff						
41CAF	- Nozzle, Rain Removal						
41CAH	- Panel Assy, Ext Env Contl						
41CAL	- Stab., Contl, Hot Air Temp						
41CA9	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL A-7D (MA)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11AC0	Windshield Assy						
11ACA	- W/S Assy Center	215-20394-1	1560-00-852-8043		4	Chipped	25.5
11ACB	- W/S Assy, LH	215-20396-1	15600-00-852-8051	879.00	1	scored or scratchd	32.5
11ACB	- W/S Assy, RH	215-20396-2	1560-00-852-8054	879.00			
11ACC	- Cowl Decking	215-20078-258	1560-00-469-7130	604.02			
11ACD	- W/S Frame Assy	215-20462-2	1560-00-852-8875				
11ACE	- W/S Glass Assy, Tempered	216-20394-1	1560-00-468-0781	453.00			
11AC9	- Noc						
12A00	Canopy System						
12AA0	- Canopy Assy	215-20079-103	1560-00-011-6206	5,172.00	2	scored,	19.6
12AAA	- Glass Canopy	215-20079-129	1560-00-852-8055	1,210.00	3	or scratchd	44.5
12AAB	- Seal Assy, Canopy	6328-1	5330-00-853-3563	57.00			
12AAC	- Bolt, Pivot	215-20425-1	5306-00-852-8824	69.00(2)			
12AA9	- Noc						
12ABE	Act. Assembly Canopy					(3)	

(2) Per set
(3) Not listed

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL A-37A/B (GP)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11100	Windshield & Canopy						
11110	Windshield Assy	4011530-42	1560-01-xxx-xxxx				
1111A	- Glass Panel, RH	4011707-106	1560-00-841-5327	449.42	2	Crazed	33.8
1111B	- Glass Panel, LH	4011707-105	1560-00-841-5324	602.60	5	Crazed	35.8
11113	- Retainer						
11114	- Magnesium Rod						
11115	- Orlon Edge						
11116	- Seal Bow						
11120	Canopy, Jettisonable (Group I)						
1112A	- Seal	4011700-35	1560-00-627-0845	7.04	3	Deteri-orated	64.8
1112B	- Glass, Canopy Pnl, LH	4011708-25	1560-00-841-5553	981.18			
1112B	- Glass, Canopy Pnl, RH	4011708-24	1560-00-941-5556	1,039.06			
11121	- Canopy Assy	4011700-302	1560-00-839-9777	10,215.00	4	Crazed	33.4
11122	- Frame	4011710-1					
11123	- Retainer						
11124	- Canopy Actuator	R550M15-1	1680-00-541-8919	2,628.00	1	Adjmt/ impropr align.	28.0
11130	Canopy, Jettisonable (Group II)						
11140	Canopy, Jettisonable (Electrical)						
11199	Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C-5A (JH)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11AXX	Windshields & Windows						
11AAA	- W/S Panel, Center	4F11000-101A	1560-00-839-4588	2,109.30	1	Cracked	30.1
11AAB	- W/S Panel, Main LH	4F11102-101A	1560-00-075-8909	1,783.57	2	Cracked	51.1
11AAC	- W/S Panel, Main RH	4F11102-102A	1560-00-075-8910	1,783.57	3	Cracked	28.1
11AAD	- W/S Panel, Side LH	4F11101-101A	1560-00-075-8911	1,433.25	4	Cracked	20.0
11AAE	- W/S panel, Side RH	4F11101-102A	1560-00-075-8912	1435.94			
11AAF	- W/S Panel, Clear Vision LH	4F11103-101A	1560-00-075-8936	1,180.21	5	Loose/ damg'd bolts, nut	14.9
11AAG	- W/S Panel, Clear Vision RH	4F11103-102A	1560-00-075-8927	1,391.00			
11AA9	- Noc						
11ACA	- Window, Side Fus Inner, LH & RH	4F13013-101B	1560-00-072-0782	45.83			
11ACA	- Window, Side Fus, Outer, LH & RH	4F13012-101A	1560-00-072-0780	45.35			
11ACA	- Window, Scanning, Inner, LH & RH	4F11466-101B	1560-00-344-3767	44.36			
11ACA	- Window, Scanning, Outer, LH & RH	4F11467-101A	1560-00-344-3651	60.67			
11AGA	- Position'g Mech, Clr Vis W/S, LH						
11AGB	- Position'g Mech, Clr Vis W/S, RH						
11AGC	- Latch Mech, Clr Vis W/S, LH						
11AGD	- Latch Mech, Clr Vis W/S, RH						
11AG9	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C-5A (JH)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	$ of MMH
41V00	W/S, Defog/Anti-ice Sys						
41VDA	- Switch, Cold Start, Anti-ice						
41VDB	- Switch, Pwr Cutoff						
41VDC	- Switch, W/S Heat						
41VDD	- Switch, W/S Heat Ctr, Anti-ice						
41VDE	- Contl Box, W/S Defog						
41VDF	- Contl Box, W/S Anti-ice						
41VDG	- Transformer, W/S Defog						
41VDH	- Transformer, W/S Anti-ice						
41VDJ	- Transformer, Heat Ctr, Anti-ice						
41VDK	- Relay, Side W/S Ht Contl, Defog						
41VDL	- Relay, W/S Ht Ctr, W/S Anti-ice						
41VD9	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C-9A

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11100	Forward Fuselage						
11130	- Windshield						
11131	- W/S Panel Assy, Center	5887275-501		2,983.00	1	Cracked	39.6
11131	- W/S Panel Assy, Side LH	5912290-1		3,620.00			
11131	- W/S Panel Assy, Side RH	5912290-2		3,620.00			
11132	- Frame						
11133	- Seal						
11139	- Noc						
11140	- Window Panel Assy, Upr LH	5912415-1		7,171.00	5	Scored or scratchd	17.9
11140	- Window Panel Assy, Upr RH	5912415-2		7,171.00			
11141	- Frame						
11149	- Noc						
11150	- Window Panel Assy, Clr Vis LH	5912426-1		5,727.00	2	Delam	20.5
11150	- Window Panel Assy, Clr Vis RH	5912426-2		5,727.00			
11151	- Frame						
11152	- Seal						
11153	- Track						
11154	- Latch						
11155	- Hinge						
11159	- Noc						
11220	- Window, Cabin						
11221	- Panel, Cabin Inner	3912038-1		162.00			
11221	- Panel, Cabin Outer	3912039-1		162.00			
11222	- Frame						
11229	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C-9A

Work Unit Code	Desciiption	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
41700	Windows & W/S Anti-icing & Antifog Sys				3	Failed to opr	o4.3
4171A	- Switch, W/S Thermal						
4171B	- Switch, W/S Ice Protection						
4171C	- Relay, W/S Artifogging						
41711	- Detector, W/S Over/Under Temp						
41712	- Controller, W/S Temp				4	Intern. failure	43.0
41713	- Relay, W/S Heat Caution						
41714	- Transformer, W/S Anti-ice						
41715	- Sensor, W/S Temp						
41716	- Element, Window Heating						
41717	- Element, W/S Heating						
41718	- Switch, Window Thermal						
41719	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C-130A/E (LG)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11000	Airframe						
11100	- Windshield & Windows						
11110	- Windshield						
1111A	- Fwd Lwr, Pnl, RH	338128R	1560-00-098-7911	411.09			
1111B	- Retainer						
1111K	- Frt Pnl, LH	338124-9	1560-00-962-3511	636.01			
1111L	- Side Pnl, LH	338125-9	1560-00-962-3513	564.64	3	Cracked	22.7
1111M	- Aft Pnl, LH	338126-9	1560-00-307-1727	399.00			
1111N	- Clr, Vis, LH	338135-9	1560-00-098-7914	386.91			
1111P	- Fwd Upr, Pnl, LH	338127-9	1560-00-962-3515	501.68	2	Cracked	46.4
1111Q	- Fwd Lwr, Pnl, RH	338128-9	1560-00-966-3515	697.64			
11111	- Ctr Pnl	337279-9	1560-00-035-2136	633.01	1	Cracked	29.5
11112	- Frt Pnl, RH	338124-10	1560-00-307-1724	614.18			
11113	- Side Pnl, RH	338125-10	1560-00-962-3514	556.14	5	Delam	29.7
11114	- Aft Pnl, RH	338126-10	1560-00-307-1728	376.00			
11115	- Clr Vis, RH	338135-10	1560-00-098-7915	441.38			
11118	- Fwd Upr, Pnl, RH	338127-10	1560-00-035-2153	393.01			
11120	- Windows						
1112A	- Side Fus, Inner						
1112B	- Side Fus, Outer						
1112C	- Side Fus, Inner						
1112D	- Side Fus, Outer						
1112E	- Scanner						
1112F	- Fwd, Flt Deck, LH	338129L	1560-00-307-1730	447.37			
1112G	- Aft, Flt Deck, LH	338130L	1560-00-098-7912	471.55			
1112H	- Side, Flt Deck, LH						
1112U	- Scanner						
11121	- Fwd, Flt Deck, RH	338129-R	1560-00-307-1731	447.37			
11122	- Aft, Flt Deck, RH	338130-R	1560-00-307-1732	453.47			
11123	- Side, Flt Deck, RH						
11199	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C-130A/E (LG)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	$ of MMH
41540	- Windshield Anti-ice				4	Failed to opr	26.8
41541	- Relay						
41542	- Rheostat						
41543	- Thermistor						
41544	- Transformer						
41545	- Control Box						
41546	- Heating Element						
41549	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C/KC-135 (FL)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11140	Aircraft Windows						
1114A	- Boom Sighting	7225079-10	1560-00-499-3683	171.41	2	Loose/ dmgd bolts, nut	18.1
1114B	- Boom Scanning, LH	5-95805-7	1560-00-575-9572	677.10			
1114B	- Boom Scanning, RH	5-95805-8	1560-00-575-9573	689.19			
1114H	- Pilot's, No. 1	5-89354-501	1560-01-052-8031	1,365.32	1	Loose/ dmgd bolts, nut	15.6
1114H	- Copilot's, No. 1	5-89354-502	1560-01-052-8032	1,365.32			
1114J	- Pilot's, No. 2 Sliding	5-89355-23			4	Loose/ dmgd bolts, nut	8.3
1114J	- Copilot's, No. 2 Sliding	5-89355-24					
1114K	- Pilot's, No. 3	5-89356-1	1560-00-575-6302	623.17	3	Loose/ dmgd bolts, nut	14.7
1114K	- Copilot's, No. 3	5-89356-2	1560-00-575-6297	653.98			
1114L	- Pilot's, No. 4	5-89357-1	1560-00-575-6299	672.92	5	Loose, dmgd bolts, nut	16.0
1114L	- Copilot's, No. 4	5-89357-2	1560-00-575-6298	600.38			
1114M	- Pilot's, No. 5	5-89358-1	1560-00-575-6300	559.93			
1114M	- Copilot's, No. 5	5-89358-2	1560-00-575-6301	618.89			
1114T	- Wing Scanner Window						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C/KC-135 (FL)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11150	- Sliding Window						
1115A	- Window Assy						
1115B	- Bearing Glide						
1115C	- Bellcrank, Lwr						
1115D	- Bellcrank, Upr						
1115F	- Glide						
1115H	- Guide						
1115J	- Handle						
1115K	- Lock, Window, Open						
1115P	- Plate Lock						
1115R	- Rod Assy						
1115S	- Rod Lock Mech						
1115T	- Shaft, Lwr Aft Bellcrank						
1115U	- Shaft, Lwr Fwd Bellcrank						
1115W	- Spring Trigger Return						
1115X	- Suppt, Lock Rod						
1115Y	- Stop, Window Lock						
1115Z	- Track Guide Pin						
11151	- Track Lwr						
11152	- Track Upr						
11153	- Trigger						
11155	- Fairing Frame						
11156	- Frame						
11157	- Parting Medium						
11158	- Strip Backing						
11159	- Noc						
41130	- Window Defrost						
41131	- Duct						
41132	- Shutoff Door						
41133	- Defrost Valve						
41134	- Anemostat						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C/KC-135 (FL)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
41140	- Windshield, Rain Removal Sys						
4114A	- Motor, Wiper						
4114B	- Converter, Wiper						
4114C	- Switch, Wiper						
4114D	- Light Assy, Wiper						
4114E	- Arm, Wiper						
4114F	- Container, Repellent						
4114G	- Sight Gauge, Repellent						
4114H	- Switch, Selector						
41141	- Nozzle						
41142	- Duct						
41143	- Drain						
41144	- Shutoff Valve						
41145	- Relief Valve						
41146	- Check Valve						
41147	- Nozzle Fairing						
41148	- Y-Connection						
41149	- Noc						
41350	- NESA Anti-ice						
41351	- Controller Amplifier						
41353	- Thermal Switch						
41354	- Relay						
41355	- Controller Bridge Rack						
41357	- Control Switch						
41358	- Window Defrost Switch						
41359	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C-141A (JH)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11AAX	Windshields						
11AAA	- Center Panel	3F20182-101	1560-00-07[illegible]-8908	1,088.19	3	Cracked	13.7
11AAB	- Front Panel - Pilot's	3F20183-101	1560-0[illegible]-8909	1,783.57	1	Cracked	30.2
11AAC	- Side Panel, Pilot's	3F20184-101	1560-00-075-8911	1,433.25	4	Scored or scratchd	9.9
11AAC	- Side Panel, Copilot's	3F20184-102	1560-00-075-8912	1,435.94			
11AAD	- Clear Vision Pnl, Pilot's	3F20186-101	1560-00-075-8936	1,180.21	2	Adjmt/ impropr algnmt	13.1
11AAD	- Clear Vision Pnl, Copilot's	3F20186-102	1560-00-075-8927	1,391.00			
11AAE	- Handle Assy, Clr Vis Pnl	3F21305-101	1560-00-907-9930	19.08			
11AAE	- Handle Assy, Clr Vis Pnl	3F21305-102	1560-00-907-9931	19.08			
11AAS	- Plate, Clr Vis Pnl Guide Channel	3F21229-101	1560-00-077-0169				
11AAT	- Guide Track, Clr Vis Pnl	3F21145-101	1560-00-075-8984	88.59			
11AAT	- Guide Track, Clr Vis Pnl	3F21145-102	1560-00-075-8985	132.33			
11AAU	- Front Panel, Copilot's	3F20183-102	1560-00-075-8910	1,783.57	5	Cracked	31.6
11ABX	Windows						
11ABA	- Cargo Area Window						
11ABB	- Retainer, Cargo Area Window						
11ABC	- Seal, Cargo Area Window						
11A99	- Noc						
41E00	Anti-ice & Defrost						
41ED0	- Heated W/S Sys						
41EDA	- Relay, High/Normal Heat						
41EDB	- Control Box						
41EDC	- Transformer						
41EDD	- Circuit Breaker						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL C-141A (JH)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	$ of MMH
41EE0	- Heated Side Pnl & Clr Vis W/S						
41EEA	- Control Box						
41EEB	- Relay Side W/S Heat						
41EEC	- Transformer						
41EED	- Sensor Primary						
41EEE	- Sensor Spare						
41EEF	- Switch Clr Vis						
41E99	- Noc						
41F00	Rain Removal Sys						
41FAA	- Relay Overheat Control						
41FAB	- Switch Control						
41FAD	- Rectifier						
41FBA	- Press. Reg & Shutoff						
41FBB	- Valve, Shutoff						
41FCA	- Nozzle Assy						
41F99	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL F/RF-4C/D/E (BF)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	ISC Rank	Major How Mal	% of MMH
111AX	Forward Fuselage						
111AN	- Glass W/S, Side Panel RH	32-35008-40	1560-00-077-0859	332.24	4	Scored or scratchd	26.1
111AP	- Glass W/S, Side Panel LH	32-35008-43	1560-00-076-2486	343.90	3	Scored or scratchd	27.1
111AQ	- Panel Assy, W/S, Flat, Ctr	32-35007-17	1560-00-437-5445	666.18	5	Cracked	29.6
123XX	Canopy System						
12320	- Fwd Canopy Assy				1	Adjmt/ impropr aligmnt	21.3
1232A	- Glass Assy	32-35209-1	1560-00-788-6502	1,139.95			
1232D	- Structure						
12350	- Aft Canopy Assy				2	Adjmt/ impropr aligmnt	22.7
1235A	- Glass Assy	32-35210-1	1560-00-788-6561	1,251.90			
1235D	- Structures						
12399	- Noc						
41300	Rain Removal System						
41310	- Sensor, W/S Temp						
41320	- Valve & Activator Assy						
41330	- Nozzle, W/S						
41350	- Control W/S, Temp Sensing						
41360	- Duct						
41370	- Valve Air Shutoff						
41399	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL F/TF-15 (FX)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11A00	Fuselage Structure						
11AF0	- Struct Assy, W/S				2	Delam	38.6
11AFA	- Frame	68A350607-1001	1560-00-271-0901	130.00			
11AFB	- Transparency, W/S	68A350002-2023	1560-00-314-3230	10,737.00			
11AFB	- Transparency, W/S	68A350002-2025	1560-00-314-3331	10,519.85			
11A99	- Noc						
12C00	- Canopy System						
12CA0	- Canopy Movable	68A350004-2099	1560-01-034-5856	21,052.08	1	Delam	24.1
12CA0	- Canopy Movable	68A350010-1005	1560-01-xxx-xxxx				
12CAA	- Glass, Canopy Fwd	68B358001-119	1560-01-019-9970	3,072.75			
12CAA	- Glass, Canopy Aft	68B358001-103	1560-00-279-6230	4,275.23			
12CAA	- Glass, Canopy Fwd	68B358004-119	1560-00-280-0686	5,156.00			
12CAA	- Glass, Canopy Aft	68B358004-121	1560-00-280-0695	4,752.00			
12CAB	- Struct Assy	68A350005-1015	1560-01-xxx-xxxx				
12CAB	- Struct Assy	68B350011-1011	1560-01-xxx-xxxx				
12C99	- Noc						
41C00	- Windshield Clearing						
41CA0	- W/S Anti-ice Sys						
41CAA	- Valve, Reg Fluid						
41CAB	- Solenoid Assy						
41CAC	- Sensor, O/H, W/S						
41CAH	- Duct Sys, Hot Air						
41CC0	- Antifog Sys						
41CCA	- Valve, W/S, Antifog						
41CCB	- Sensor, Temp, Antifog						
41CCC	- Valve, C.H., Low Press.				5	(1)	
41CCD	- Ht Exchgr, Air						
16ABA	- Hatch LH				3	(2)	
16AAD	- Glass RH				4	(2)	

(1) No AFM 66-1 Data (2) Not listed

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL F-105B/D/F/G (NE)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	$ o MMH
11121	Windshield Assy						
11122	- Panel, Front	57F170103-13	1560-00-731-6203	527.65			
11123	- Panel, Left	57F171101-7-1	1560-00-973-0199	977.65	2	Scored or scratchd	16.[illegible]
11124	- Panel, Right	57F171101-8-1	1560-00-973-0198	977.65	4	Scored or	24.2
11199	- Noc						
1212L	Window, Windscreen				5	Cracked	20.1
12199	- Noc						
122xx	Canopy System						
12221	- Canopy				1	Adjmt/ impropr algnmt	9.4
12223	- Canopy Glass	57F171604-9-1	1560-00-672-2145	3,594.90	3	Crazed	16.8
12299	- Noc						
12241	Canopy System						
12242	- Canopy Glass	31F170604-1-1	1560-00-996-4460	3,489.17			
12299	- Noc						
4171X	Windshield Defog Sys						
41714	- Valve, Shutoff, Defrost						
41715	- Valve, Shutoff, Manual						
41716	- Perforated Tubes						
41721	- Control Box, W/S						
41723	- Thermostat, W/S	25820013	5930-00-691-2708				
41799	- Noc						
4181X	Rain Removal Sys						
41811	- Duct, Hot Air						
41812	- Air Outlet Nozzle						
41813	- Valve, Shutoff						
41815	- Control, Shutoff						
41821	- Switch						
41899	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL T-37B (SE)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11100	Windshield & Canopy						
11110	Windshield						
11111	- Windshield Assy, LH	4011707-103	1560-00-536-7279	243.53	2	Crazed	16.0
11111	- Windshield Assy, RH	4011707-104	1560-00-536-7280	243.01			
11112	- Glass Panel, LH	4011546-305	1560-01-xxx-xxxx		4	Crazed	40.9
11112	- Glass Panel, RH	4011546-306	1560-01-xxx-xxxx				
11113	- Retainer						
11114	- Magnesium Rod						
11115	- Orlon Edge						
11120	Canopy, Jettisonable (Group I)						
1112A	- Seal	4011700-35	1560-00-627-0845	7.04	3	Torn	36.0
1112B	- Glass, Canopy Pnl, LH	4011708-23	1560-00-326-3195	433.17	5	Crazed	42.3
1112B	- Glass, Canopy Pnl, RH	4011708-22	1560-00-326-3196	413.56			
11121	- Canopy Assy	4011700-301	1560-00-564-5709	4,587.00	1	Crazed	24.6
11122	- Frame	4011710-1					
11123	- Retainer						
11124	Canopy Actuator	R550M15-1	1680-00-541-8919	2,628.00			
11130	Canopy, Jettisonable (Grp II)						
11140	Canopy, Jettisonable (Elect.)						
11199	Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL T-38A (XE)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	$ o MMH
111XX	Windshield Assy, Front (Group I)						
11111	- W/S Assy, Students	3-13014-3	1560-00-400-0559	2,195.64	3	Chipped	9.
11112	- Frame						
11114	- Fairing, W/S LH	3-13009-1	1560-00-400-3876	90.68			
11114	- Fairing, W/S RH	3-13009-2	15600-00-400-3877	90.56			
11115	- Seal, Press.						
11117	- Suppt Brkt						
11118	- Hinge Brkt						
1112X	Windshield Assy, Front (Group II)						
11121	- Crank						
11122	- Rod						
11123	- Hinge Pin						
11124	- Piano Hinge						
11125	- Panel, W/S	3-13014-3	1560-00-400-0559	2,195.64	4	Chipped	32.
11126	- Bolt, Holddown						
1113X	Windshield Assy, Rear						
11131	- W/S Assy, Instructors	2-13101-1					
11132	- Frame						
11133	- Support						
11136	- Panel, W/S, Instructors	3-13101-9	1560-00-960-7955	226.31			
112XX	Canopy Assy, Front						
11211	Canopy Assy				1	Adjmt/ impropr algnmt	33.1
11212	- Panel Assy, Students	2-13201-53	1560-00-996-1399	1,704.51			
11213	- Frame						
11214	- Fairing, Side	2-13214-7	1560-00-790-5023	84.64			
11216	- Beam						
11217	- Support						
11218	- Seal	S10485-3	1560-00-710-2309	102.05			
11219	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL T-38A (XE)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal
113XX	Canopy Assy, Rear					
11311	Canopy Assy	2-13300-509	1560-00-894-2890	25,271.26	2	Adjmt/ impropr algmt
11312	- Panel Assy, Instructor's	2 13300-35	1560-00-863-4491	1,270.09	5	Scored or scratch
11313	- Frame					
11314	- Fairing	2-13310-5	1560-00-790-5020	236.04		
11315	- Roller					
11316	- Beam					
11317	- Support					
11318	- Seal	S10485.5	1560-00-710-2310	88.10		
11319	- Noc					

REFERENCES

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL T-39A (XF)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11110	Windshield				4	Delam	15.2
11111	- W/S Panel, Glass, LH	E1117-1	1560-00-888-5761	1,351.04	3	Delam	28.5
11111	- W/S Panel, Glass, RH	E1117-2	1560-00-888-5762	1,351.04			
11114	- Frame	265-318002-3	1560-00-400-9366	45.18			
11114	- Frame	265-318002-5	1560-00-400-9367	89.74			
11120	- Pilot's, Sliding Window	265-138371-21	1560-00-956-3604	2,870.00	2	Adjmt/ impropr algnmt	28.9
1112D	- Track, Upper	265-318309	1560-00-796-8055	87.04			
1112E	- Track, Lower	265-318310-101	1560-00-734-1418	302.28			
11122	- Copilot's, Sliding Window	265-318372-51	1560-00-018-2328	2,110.04			
11123	- Fame	265-318322					
11140	Cockpit, Window Assy						
1114A	- Lwr, Fwd, Pnl, Inner	265-318208-11	1560-00-476-1629	1,757.94			
1114B	- Lwr, Fwd, Pnl, Outer	265-318208-511		1,757.94			
11142	- Lwr, Aft Pnl, Inner, LH	265-318204-81	1560-00-784-8249	335.88			
11142	- Lwr, Aft Pnl, Inner, RH	265-318204-82	1560-00-784-8250	381.17			
11143	- Lwr, Aft Pnl, Outer, LH	265-318204-71	1560-00-784-8247	4[illegible].85			
11143	- Lwr, Aft Pnl, Outer, RH	265-318204-72	1560-00-794-8248	501.10			
11144	- Upr, Aft Pnl, Inner, LH	265-318206-81	1560-00-784-8257	321.68			
11144	- Upr, Aft Pnl, Inner, RH	265-318206-82	1560-00-794-8258	353.62			
11145	- Upr, Fwd Pnl, Outer, LH	265-318206-71	1560-00-784-8255	451.44			
11145	- Upr, Fwd Pnl, Outer, RH	265-318206-72	1560-00-784-8256	448.88			
11146	- Upr, Fwd Pnl, Inner, LH	265-318207-1	1560-00-506-1312	1,431.15			
11146	- Upr, Fwd Pnl, Inner, RH	265-318207-2	1560-00-506-1314	1,385.20			
11147	- Upr, Fwd Pnl, Outer, LH	265-318205-11	1560-00-785-8686	611.22			
11147	- Upr, Fwd Pnl, Outer, RH	265-318205-12	1560-00-784-8252	714.71			
11170	Cabin, Window Assy						
11172	- Inner, Aft Pnl	265-300050-81	1560-00-963-7181	377.92			
11173	- Outer, Aft Pnl	265-300050-71	1560-00-785-2223	523.44			
11174	- Inner, Fwd Pnl	265-300050-21	1560-00-963-7181	377.92			
11175	- Outer, Fwd Pnl	265-300050-11	1560-00-785-2223	523.44			
11199	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL T-39A (XF)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
41530	W/S, Heating & Anti-icing Sys				5	Failed to opr	47.7
41531	- Heating Element						
41532	- Sensing Element						
41533	- Overheat Thermoswitch						
41535	- Controller				1	Intnl failure	30.6
41535	- Controller, W/S Heat	SCV896-4	1660-00-566-6803	2,337.00			
41536	- Switch, W/S Heat	8-1903-1	5930-00-996-1287	10.81			
41599	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL 0-2 (CG)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11000	Airframe Fuselage						
11AP1	- Window Assy				1	Dirty contam saturat	29.3
	- Cabin Top Fwd	1511313-1	1560-00-901-6540	14.82			
	- Cabin Top Aft	1511313-4	1560-00-901-6541	5.35			
	- Lower Cabin	1513314-2	1560-00-903-1929	10.63			
	- Middle LH	1511015-1	1560-00-932-6235	13.31			
	- Middle RH	1511015-2	1560-00-932-6236	14.87			
	- Aft Fus LH	1412312-9	1560-00-932-5964	8.53			
	- Aft Fus RH	1412312-10	1560-00-932-5963	7.05			
11AQ1	- Foul Weather	1513700-10	1560-00-888-8190	6.14	5	Cracked	32.9
11AR1	- Emergency				4	Crazed	15.1
11AS1	- Windshield Assy	1413702-5	1560-00-903-0054	121.77	2	Crazed	[illegible].5
11AS1	- Windshield Assy	1413702-6		121.77			
11AUC	- Window, Cabin Door	1511231-2	1560-00-901-5134	11.41	3	Crazed	26.4
11AUC	- Window, Cabin Door	1411312-4	1560-00-689-8535	11.38			
11A99	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL OV-10A (EW)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11AXX	Transparency System						
11AAA	- Glass, W/S Armor	300-318032	1560-00-899-3749	544.00	3	Cracked	36.5
11AAB	- Glass, Top Fwd Canopy	300-318080-201	1560-00-824-6505	1,340.00	2	Cracked	8.1
11AAC	- Glass, Top Aft Canopy	300-318085-101	1560-00-824-6530	1,540.00	1	Cracked	15.7
11AAD	- Glass, Rt Pilot Canopy Door	300-318137-2	1560-00-824-6537	489.00	4	Scored or scratchd	22.6
11AAE	- Glass, Lt Pilot Canopy Door	300-318137-11	1560-00-824-6588	647.00			
11AAF	- Glass, Rt Obs Canopy Door	300-318138-2	1560-00-827-3393	401.00			
11AAG	- Glass, Lt Obs Canopy Door	300-318138-31	1560-00-816-9483	308.00			
11AAH	- Glass, Rt W/S Side Panel	300-318136-22	1560-00-901-6254	963.00			
11AAJ	- Glass Lt W/S Side Panel	300-318136-21	1560-00-719-6992	346.00	5	Cracked	44.6
11AAK	- Glass Rt Fus Sta 136 to 141.8	300-318139-6	1560-00-824-2712	105.00			
11AAL	- Glass Lt Fus Sta 136 to 141.8	300-318139-5	1560-00-824-2711	105.00			
11A99	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL CH/HH-3C/E (TH)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11100	Airframe Components						
11110	- Forward Exterior						
1111E	- W/S Assy Cockpit, LH	E133400-1	1560-00-828-5938	1,239.06	1	Scored or scratchd	30.9
1111E	- W/S Assy Cockpit, RH	E133400-2	1560-00-828-5934	1,235.85			
11111	- Window Assy, Sliding, LH	S6120-61330-11	1560-00-824-7198	327.88	2	Cracked	17.4
11111	- Window Assy, Sliding, RH	S6120-61330-12	1560-00-824-7205	366.43			
11111	- Window, Stationary, LH	S6120-61235-5	1560-00-824-7314	19.08			
11111	- Window, Stationary, RH	S6120-61235-6	1560-00-074-4166	19.08			
11111	- Window, Upr, Observ, LH	S6120-61245-1	1560-00-700-1835	172.00			
11111	- Window, Upr, Observ, RH	S6120-61245-2	1560-00-700-1836	172.00			
11111	- Window, Frt, Corner, LH	S6120-61227-3	1560-00-824-7246	684.37			
11111	- Window, Frt, Corner, RH	S6120-61227-4	1560-00-074-4164	655.80			
11111	- Window, Frt, Center	S6120-61229-5	1560-00-074-4165	104.75			
11111	- Window, Lwr, Observ, LH	S6120-61246-3	1560-00-824-7086	192.28			
11111	- Window, Lwr, Observ, RH	S6120-61246-4	1560-00-824-7195	192.28			
11112	- Seal						
11113	- Channel						
11199	- Noc						
41200	- Anti-icing Sys				5	(1)	
41210	- Windshield				3	Failed to opr	16.7
41211	- Switch, Control						
41212	- Controller, Temp				4	Shorted	22.7
41213	- Transformer						
41299	- Noc						

(1) No AFM 66-1 data.

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Continued)
MODEL CH/HH-53B/C (BZ)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11100	Cockpit & Canopy						
11110	- General						
1111B	- Windshield, LH	E1204-1	1560-00-943-5002	1,290.00	2	Cracked	25.1
1111C	- Windshield, RH	E1204-2	1560-00-943-5004	1,290.00	3	Cracked	25.1
1111D	- Windshield, Ctr	E1203	1560-00-943-5002	831.00			
11111	- Window, Bottom, Nose, LH	65206-01007-101	1560-00-938-9590	404.00	1	Scored or scratchd	31.0
11111	- Window, Bottom, Nose, RH	65206-01007-102	1560-00-938-9591	356.00			
11111	- Window, Cockpit Escape, LH	65206-01008-105	1560-00-932-5474	126.00			
11111	- Window, Cockpit Escape, RH	65206-01008-106	1560-00-932-5475	282.00			
11118	- Frame						
11199	- Noc						
41200	- Anti-icing Sys						
41210	- Windshield				5	Failed to opr	23.6
41211	- Control Switch						
41212	- Temp Controller				4	Failed to opr	68.8
41213	- Sensing Element						
41214	- Relay						
41299	- Noc						

TABLE A1. MASTER TRANSPARENCY SYSTEM LIST (Concluded)
MODEL UH/TH-1F & UH-1P (GA)

Work Unit Code	Description	Part Number	National Stock Number	Unit Cost ($)	LSC Rank	Major How Mal	% of MMH
11XXX	Airframe Cabin Exterior						
11110	- Crew Door				2	Loose/ dmgd bolts, nut	17.0
11111	- Door						
11112	- Frame						
11113	- Window Assy, Fwd, LH	204-030-459-1	1560-00-690-7285	61.15	4	Crazed	36.8
11113	- Window Assy, Fwd, RH	204-030-459-2	1560-00-690-7286	72.98			
11113	- Window Assy, Top, LH	204-030-770-1	1560-00-690-7288	85.10			
11113	- Window Assy, Top, RH	204-030-770-2	1560-00-690-7289	85.10			
11113	- Window Assy, Sliding	204-030-799-1	1560-00-690-7290	35.60			
11114	- Handle						
11115	- Latch						
11116	- Hinge						
11130	- Cargo Door				1	Loose/ dmgd bolts, nut	19.4
11131	- Door				3	Loose/ dmgd bolts, nut	35.3
11132	- Window Assy, LH & RH	204-031-340-1	1560-00-518-6873	130.29			
11133	- Handle						
11140	- Structure Exterior						
11145	- Window Assy, Cabin Roof, LH	204-030-673-3	1560-00-672-4800	289.00	5	Cracked	28.0
11145	- Window Assy, Cabin Roof, RH	204-030-673-23	1560-00-787-4251	318.00			
11145	- Window Assy, Cabin Nose, LH	204-030-657-19	1560-00-701-9923	221.00			
11145	- Window Assy, Cabin Nose, RH	204-030-657-20	1560-00-701-9924	635.00			
11146	- Windshield Assy, LH	204-030-666-31	1560-876-2405	450.00			
11146	- Windshield Assy, RH	204-030-666-32	1560-873-5526	450.00			
11199	- Noc						

APPENDIX B

FIGURE B-1

T-39 RELIABILITY AND MAINTAINABILITY

SUMMARY (RAM)

ROCKWELL INTERNATIONAL — LA DIVISION

SELECTED TRANSPARENCY WUCS DHAC 1/76-6/77 STAC3 — JOB NUMBER 1043-47 — JUN. 21 1979

OPERATING HOURS 172036. — AIRCRAFT TYPE T-39 — NO. OF FLIGHTS FLOWN 207203.

TERM DEFINITIONS

THERE ARE TWO LINES PER WORK UNIT CODE, SUBSYSTEM, OR SYSTEM. EXCEPT FOR THE LAST FEW COLUMNS (AS NOTED ON THE PAGES). LINE ONE IS THE COMPUTATION OF SCHEDULED MAINTENANCE ACTIONS. LINE 2 IS THE COMPUTATION OF ALL UNSCHEDULED MAINTENANCE

UNSCHEDULED MAINTENANCE INCLUDES ALL UNITS WHICH HAVE A B (UNSCHEDULED) IN THE PREFIX OF THE WORK ORDER NUMBER EXCEPT FOR THOSE ACTION TAKEN CODES INDICATING CANNIBALIZATION (CODES T AND U)

MEAN MANHOURS PER UNIT	TASK TIME	= MANHOURS / NUMBER OF UNITS
MEAN MANHOURS PER FLIGHT HOUR	M.M.H/FLT HR	= MANHOURS / OPERATING HOURS
REPLACEMENT RATE	REP. RATE	= REPLACEMENTS/ NO OF FLIGHTS HOURS
MAINTENANCE RATE	MAINT RATE	NO OF UNITS/OPERATING HOURS
AIR ABORT RATE	FLT	NUMBER OF MALFUNCTIONS DISCOVERED IN FLIGHT WHICH CAUSED ABORT (WHEN DISCOVERED CODE C) DIVIDED BY OPERATING HOURS
GROUND ABORT RATE	GRD	NUMBER OF MALFUNCTIONS DISCOVERED BEFORE FLIGHT WHICH CAUSED ABORT (WHEN DISCOVERED CODE A) DIVIDED BY NUMBER OF FLIGHTS
REPLACEMENTS	REP	TOTAL NUMBER OF SPARES (REPLACEMENTS) REQUIRED FOR THIS UNIT (ACTION TAKEN CODES P AND R)

NOTATION FOR FIGURE B-1

::::::::: - EXCEEDS PRINT FORMAT

TASK TIME - HOURS

STND DEV - HOURS

MTBMA - HOURS

MTBUR - HOURS

GRD ABORT RATES - NO. OF FLIGHTS

FLT ABORT RATES - NO. OF HOURS

Figure B-1. T-39 Reliability and Maintainability Summary (RAM)

ROCKWELL INTERNATIONAL — LA DIVISION

SELECTED TRANSPARENCY WUCS DNAC 1/76-6/77 STAC3 JOB NUMBER 1043-47 JUN. 21 1978
OPERATING HOURS 172036. AIRCRAFT TYPE T-39 NO. OF FLIGHTS FLOWN 207203.

TWO LINES PER CODE: LINE ONE SCHEDULED. LINE TWO UNSCHEDULED. LAST COLUMN AS NOTED. * = 0.0 UNITS

WUC	MAN HOURS	UNITS	TASK TIME	STND DEV	MTBMA	MMH/ FLT HR	MTBUR	REPLACEMENT TASK TIME	REPLACEMENT STND DEV	NON-REP. TASK TIME	NON-REP. STND DEV	ABORT RATES
11110	188.0	43	4.37	1.93	4000.84	1.093E-03	21504.50	2.59	0.35	4.78	1.43	GRD 0.0
	2728.5	91	29.98	4.80	1890.51	1.586E-02	6144.14	7.09	0.20	40.16	4.18	FLT 0.0
11111	479.7	27	17.77	5.81	6371.70	2.788E-03	17203.60	9.56	0.63	22.59	12.49	GRD 1.930E-05
	3769.5	123	30.65	8.25	1398.67	2.191E-02	2529.94	9.55	0.60	58.73	9.85	FLT 1.744E-05
11114	158.8	64	3.48	2.06	2688.06	9.213E-04	**********	0.0	0.0	3.48	2.06	GRD 0.0
	1633.4	148	10.88	9.60	1162.41	9.913E-03	57348.87	8.74	8.71	10.82	3.63	FLT 0.0
SUB-SUBSYSTEM												
1111	826.2	134	6.17	3.45	1283.85	4.802E-03	9557.55	6.46	0.51	8.12	5.45	GRD 1.930E-06
	8031.4	362	22.19	5.22	475.24	4.668E-02	1737.74	8.65	0.70	27.28	9.85	FLT 1.744E-05
11120	38.9	59	0.66	0.84	2915.86	2.261E-04	172036.00	0.50	0.0	0.66	0.85	GRD 0.0
	67.3	15	4.49	3.60	11469.07	3.912E-04	57345.37	7.43	2.31	3.75	2.57	FLT 0.0
1112E	52.0	48	1.08	1.90	3584.09	3.023E-04	57345.37	5.83	6.93	0.77	0.86	GRD 0.0
	193.0	25	7.72	13.12	6881.44	1.122E-03	21504.50	3.24	2.12	9.83	14.28	FLT 0.0
11120	655.6	162	4.05	3.07	1061.95	3.811E-03	19115.11	1.84	1.51	4.18	3.93	GRD 0.0
	1935.4	310	6.24	3.65	554.95	1.125E-02	4778.78	6.95	0.51	6.16	3.15	FLT 2.325E-06
11122	108.5	105	1.03	2.19	1638.44	6.307E-04	57345.37	4.33	0.35	0.94	1.73	GRD 0.0
	111.6	31	3.60	1.60	5549.55	6.487E-04	43009.02	1.45	1.00	3.92	1.68	FLT 0.0
11123	100.2	29	3.46	12.49	5932.27	5.824E-04	57345.37	0.13	0.0	3.84	12.72	GRD 0.0
	161.7	28	5.77	2.09	6144.14	9.399E-04	43009.02	5.65	2.31	5.80	1.87	FLT 0.0
SUB-SUBSYSTEM												
1112	955.2	403	2.37	4.54	426.89	5.552E-03	9054.52	2.53	3.28	2.38	4.55	GRD 0.0
	2469.0	409	6.04	4.72	420.63	1.435E-02	3127.93	5.94	1.19	6.05	4.36	FLT 2.325E-06
1114A	58.0	15	3.87	1.46	11469.07	3.371E-04	86018.00	3.25	4.24	3.96	0.35	GRD 0.0
	242.2	22	11.01	4.60	7819.82	1.408E-03	43009.02	10.95	1.75	11.02	9.41	FLT 0.0
1114E	11.2	26	0.43	0.74	6616.77	6.510E-05	**********	0.0	0.0	0.43	0.74	GRD 0.0
	200.6	32	5.27	3.15	5376.12	1.166E-03	86018.00	13.00	8.40	5.82	1.46	FLT 0.0
11140	129.3	57	2.27	3.78	3018.18	7.516E-04	57345.37	8.67	0.71	1.91	1.54	GRD 0.0
	527.0	111	4.75	7.09	1549.87	3.063E-03	28672.67	10.58	1.63	4.41	4.51	FLT 0.0
11142	111.1	27	4.11	1.69	6371.70	6.458E-04	**********	0.0	0.0	4.11	1.59	GRD 0.0
	590.1	28	21.07	5.43	6144.14	3.430E-03	14336.33	9.48	0.59	30.54	5.96	FLT 0.0
11143	93.6	24	3.90	3.89	7168.16	5.441E-04	172036.00	2.00	0.0	3.98	4.04	GRD 0.0
	124.2	19	6.54	4.41	9054.52	7.219E-04	57345.37	6.87	11.31	6.61	3.50	FLT 0.0

Figure B-1. T-39 Reliability and Maintainability Summary (RAM) (Continued)

ROCKWELL INTERNATIONAL - LA DIVISION

SELECTED TRANSPARENCY WUCS ONAC 1/76-6/77 STAC3   JOB NUMBER 1043-47   JUN. 21 1978
OPERATING HOURS 172036.   AIRCRAFT TYPE T-39   NO. OF FLIGHTS FLOWN 207203.

TWO LINES PER CODE. LINE ONE SCHEDULED. LINE TWO UNSCHEDULED. LAST COLUMN AS NOTED. * = 0.0 UNITS

WUC	MAN HOURS	UNITS	TASK TIME	STND DEV	MTBMA	MMH/ FLT HR	MTBUR	REPLACEMENT TASK TIME	REPLACEMENT STND DEV	NON-REP. TASK TIME	NON-REP. STND DEV	ABORT RATES
11144	116.9	30	3.90	0.60	5734.53	6.705E-04	86018.00	6.00	2.83	3.75	9.09	GRD 0.0
	294.3	18	16.35	10.51	8557.56	1.711E-03	43009.02	12.15	7.30	17.55	11.48	FLT 0.0
11145	113.1	19	5.95	0.85	9054.52	6.574E-04	86018.00	21.00	12.73	4.18	2.00	GRD 0.0
	90.4	10	9.04	6.05	17203.60	5.255E-04	172036.00	18.00	0.0	0.27	4.51	FLT 0.0
11149	248.2	75	3.31	4.06	2293.81	1.443E-03	28672.87	10.92	6.53	2.65	1.49	GRD 0.0
	1240.3	31	40.01	4.23	5549.55	7.210E-03	17203.60	0.31	2.00	55.15	40.30	FLT 0.0
11147	11.2	9	1.24	0.80	19115.11	6.510E-05	**********	0.0	0.0	1.24	0.80	GRD 0.0
	411.7	19	21.67	23.82	9054.52	2.393E-03	28672.87	7.59	1.34	28.17	27.77	FLT 0.0
SUB-SUBSYSTEM												
1114	892.6	282	3.17	4.73	610.06	5.188E-03	10752.25	0.63	5.81	2.78	3.38	GRD 0.0
	3720.8	290	12.83	9.02	593.23	2.163E-02	3584.09	9.31	4.30	13.53	17.22	FLT 0.0
11170	69.9	18	3.88	0.92	9557.65	4.063E-04	86018.00	2.50	0.71	4.06	0.69	GRD 0.0
	139.2	20	6.96	1.87	8601.80	8.091E-04	28672.67	4.08	1.81	0.19	2.02	FLT 0.0
11172	14.2	6	2.37	1.56	28672.67	8.254E-05	**********	0.0	0.0	2.37	1.56	GRD 0.0
	80.5	21	3.83	5.38	8192.19	4.679E-04	86018.00	10.00	2.83	3.18	0.99	FLT 0.0
11173	1.5	2	0.75	0.35	86018.00	8.719E-06	**********	0.0	0.0	0.75	0.35	GRD 0.0
	45.8	6	7.63	0.69	28672.67	2.662E-04	86018.00	6.50	3.54	8.20	0.37	FLT 0.0
11174	10.0	4	2.50	1.44	43009.02	5.813E-05	**********	0.0	0.0	2.50	1.44	GRD 0.0
	122.4	8	15.30	7.51	21504.50	7.115E-04	57345.37	5.83	4.62	29.38	9.79	FLT 5.813E-06
11175	31.6	5	6.32	3.05	34407.20	1.837E-04	**********	0.0	0.0	6.32	3.05	GRD 0.0
	106.7	43	2.48	14.36	4000.84	5.202E-04	172036.00	10.50	0.0	2.29	15.01	FLT 5.813E-06
SUB-SUBSYSTEM												
1117	127.2	35	3.63	1.68	4915.31	7.394E-04	86018.00	2.50	0.71	3.70	1.69	GRD 0.0
	494.6	98	5.05	8.22	1755.47	2.875E-03	12288.29	6.32	3.50	4.83	8.96	FLT 1.163E-05
11199	78.0	72	1.08	1.42	2389.39	4.534E-04	19115.11	1.09	1.63	1.08	1.42	GRD 0.0
	142.2	58	2.45	2.90	2966.14	8.266E-04	11469.07	1.81	0.55	2.74	3.54	FLT 0.0
SUB-SUBSYSTEM												
1119	78.0	72	1.08	1.40	2389.39	4.534E-04	19115.11	1.09	1.63	1.08	1.42	GRD 0.0
	142.2	58	2.45	2.90	2966.14	8.266E-04	11469.07	1.81	0.55	2.74	3.54	FLT 0.0

Figure B-1. T-39 Reliability and Maintainability Summary (RMS) (Continued)

ROCKWELL INTERNAT. NAL - LA DIVISION

SELECTED TRANSPARENCY WUCS DNAC 1/76-6/77 STAC3 JOB NUMBER 1093-47 JUN. 21 1978
OPERATING HOURS 172036. AIRCRAFT TYPE T-39 NO. OF FLIGHTS FLOWN 207203.

TWO LINES PER CODE. LINE ONE SCHEDULED. LINE TWO UNSCHEDULED. LAST COLUMN AS NOTED. * = 0.0 UNITS

WUC	MAN HOURS	UNITS	TASK TIME	STND DEV	MTBMA	MMH/ FLT HR	MTBUR	REPLACEMENT TASK TIME	REPLACEMENT STND DEV	NON-REP. TASK TIME	NON-REP. STND DEV	ABORT RATES
SUBSYSTEM												
111	2879.2	926	3.11	4.19	185.78	1.674E-02	2688.06	5.20	3.66	2.95	4.23	GRD 1.930E-05
	14858.0	1217	12.21	6.21	141.36	8.637E-02	744.74	7.54	2.37	13.30	9.22	FLT 5.231E-05
SYSTEM	AIRFRAME											
11	2879.2	926	3.11	4.19	185.78	1.674E-02	2688.06	5.20	3.66	2.95	4.23	GRD 1.930E-05
	14858.0	1217	12.21	6.21	141.36	8.637E-02	744.74	7.54	2.37	13.30	9.22	FLT 5.231E-05
CATEGORY												
1	2878.2	926	3.11	4.19	185.78	1.674E-02	2688.66	5.20	3.66	2.95	4.23	GRD 1.830E-05
	14858.0	1217	12.21	6.21	141.36	8.637E-02	744.74	7.54	2.37	13.30	9.22	FLT 5.231E-05
41530	241.9	68	3.67	2.02	2608.61	1.406E-03	24578.57	2.53	2.04	3.80	2.66	GRD 1.448E-05
	2020.5	332	6.09	2.89	516.18	1.174E-02	21504.50	4.64	2.47	8.12	2.91	FLT 5.813E-05
41531	103.1	23	4.48	2.28	7479.82	5.993E-04	***********	0.0	0.0	4.48	2.28	GRD 0.0
	173.4	43	4.03	3.93	4000.84	1.000E-03	***********	0.0	0.0	4.03	3.93	FLT 6.813E-06
41532	45.5	24	1.90	1.58	7168.16	2.645E-04	172036.00	4.00	0.0	1.80	1.55	GRD 0.0
	146.2	37	3.95	2.36	4649.62	8.498E-04	15639.64	3.82	0.35	4.62	2.51	FLT 0.0
41533	9.9	4	2.47	1.09	43009.02	5.755E-05	***********	0.0	0.0	2.47	1.09	GRD 0.0
	97.7	20	4.88	4.23	8301.80	5.679E-04	11469.07	3.13	0.90	10.14	7.53	FLT 0.0
41535	634.0	178	3.56	1.86	966.49	3.685E-03	19115.11	3.68	2.00	3.66	1.85	GRD 9.652E-06
	1425.6	266	5.36	2.56	646.75	8.287E-03	896.02	4.19	2.06	8.38	3.08	FLT 1.744E-05
41536	17.8	7	2.54	2.40	24576.57	1.035E-04	***********	0.0	0.0	2.54	2.40	GRD 0.0
	39.7	7	5.63	6.12	24578.57	2.256E-04	57345.37	8.00	8.24	3.87	1.83	FLT 0.0
41537	0.0	0	0.0	0.0	***********	0.0	***********	0.0	0.0	0.0	0.0	GRD 0.0
	28.4	7	4.06	2.02	24576.57	1.651E-04	57345.37	3.00	1.15	4.05	1.91	FLT 0.0
SUB-SUBSYSTEM												
4153	1052.2	302	3.48	1.94	569.66	6.116E-03	10119.78	3.21	2.05	3.50	1.95	GRD 2.413E-05
	3930.5	712	5.52	2.89	241.62	2.285E-02	741.53	4.10	1.18	8.21	2.98	FLT 8.138E-05
41599	25.0	27	0.93	1.49	6371.79	1.453E-04	34407.20	1.80	3.46	0.77	0.95	GRD 0.0
	50.6	12	4.22	3.88	14336.33	2.941E-04	24576.57	2.00	0.11	7.32	4.44	FLT 0.0
SUB-SUBSYSTEM												
4159	25.0	27	0.93	1.49	6371.70	1.453E-04	34407.20	1.60	3.40	0.77	0.95	GRD 0.0
	50.6	12	4.22	3.88	14336.33	2.941E-04	24576.57	2.00	0.11	7.32	4.44	FLT 0.0

Figure B 1. T-39 Reliability and Maintainability Summary (RAM) (Continued)

ROCKWELL INTERNATIONAL - LA DIVISION

SELECTED TRANSPARENCY WUCS QMAC 1/76-6/77 STAC3 JOB NUMBER 1043-37 JUN. 21 1978
OPERATING HOURS 172036. AIRCRAFT TYPE T-39 NO. OF FLIGHTS FLOWN 207203.

TWO LINES PER CODE. LINE ONE SCHEDULED. LINE TWO UNSCHEDULED. LAST COLUMN AS NOTED. # = 0.0 UNITS

WUC	MAN HOURS	UNITS	TASK TIME	STND DEV	MTBMA	MMH/ FLT HR	MTBUR	REPLACEMENT TASK TIME	REPLACEMENT STND DEV	NON-REP. TASK TIME	NON-REP. STND DEV	ABORT RATES
SUBSYSTEM												
416	1077.2	329	3.27	1.96	522.91	6.261E-03	7819.82	2.85	2.23	3.30	1.98	GRD 2.413E-05
	3981.1	724	5.50	2.90	237.62	2.314E-02	719.82	4.94	1.16	8.22	3.00	FLT 8.138E-05
SYSTEM	ENVIRONMENT AND ICE CONTROL											
41	1077.2	329	3.27	1.98	522.91	6.261E-03	7819.82	2.85	2.23	3.30	1.98	GRD 2.413E-05
	3981.1	724	5.50	2.90	237.62	2.314E-02	719.82	4.94	1.18	8.22	3.00	FLT 8.138E-05
CATEGORY												
4	1077.2	329	3.27	1.96	522.91	6.261E-03	7819.82	2.85	2.23	3.30	1.98	GRD 2.413E-05
	3981.1	724	5.50	2.90	237.62	2.314E-02	719.82	4.94	1.16	8.22	3.00	FLT 8.138E-05
AIRCRAFT												
T-39	3958.4	1255	3.15	3.60	137.08	2.300E-02	2000.42	4.60	3.34	3.05	3.71	GRD 4.344E-05
	18838.1	1941	5.71	5.13	88.63	1.095E-01	388.03	5.78	1.88	10.87	7.82	FLT 1.337E-04

Figure B-1. T-39 Reliability and Maintainability Summary (RAM) (Concluded)

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